The information in this booklet must not be given to the public

British Rail | Train Crew Manual

Class 31 Locomotives

Drivers Fault-Finding Data

Issue 3
Supercedes Issue 2

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FOREWORD

For ease of reference this booklet has been produced in three parts. The first, on white pages, consists of a series of illustrations which show the general layout of the locomotive together with certain components.

The second – PART A – Page 13

Deals with the original locomotives, which may be vacuum or dual braked and numbered between 31101 and 31327, or dual braked and fitted for an Electric Train Supply (ETS) and numbered between 31401 and 31424.

The fault finding charts are printed on green paper and are followed by further illustrations detailing the control and ETS cubicles.

The third – PART B – Page 37

Deals with those locomotives which have undergone a life extension refurbishment and which are all dual braked. The first to be so treated are numbered between 31425 and 31468 which are fitted to provide an ETS. Subsequent locomotives will not be rebuilt to provide an ETS and will retain their running numbers in the 31101 to 31327 series although they will be identified as refurbished locomotives by the circuit breakers now located on the end of the control cubicle and by the provision of rotary type switches for the BIS and for exhauster isolation in place of the former knife type switches, the latter taking the place of the earth isolating switch. Driver will also notice the transparent lower panels of the control cubicle at No.2 end of the locomotive.

It should also be noted that locomotives 31401 to 31424 will be refurbished at their next classified repair but they will not be electrically identical to the later Clas 31/4 locomotives 31425 to 31468, hence it has been necessary to deal with them separately in the fault finding charts.

The fault finding charts for these refurbished locomotives are on pink paper and are followed by illustrations detailing the control and ETS cubicles.

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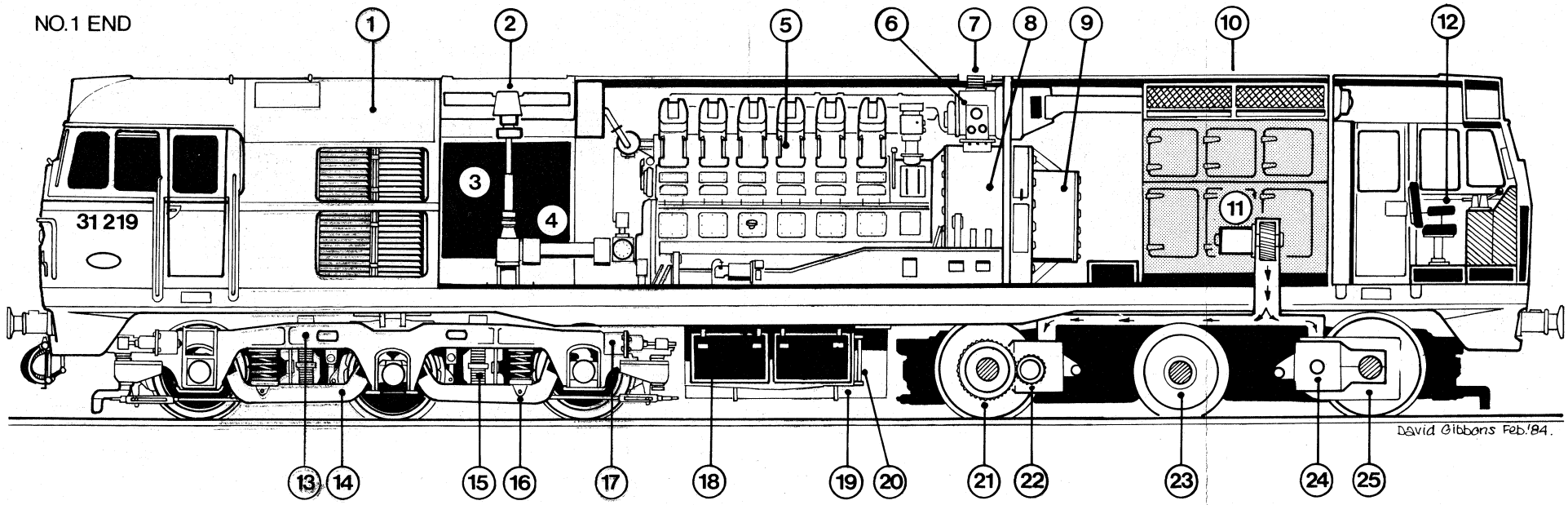
Fig.1 General Features



KEY TO NUMBERS

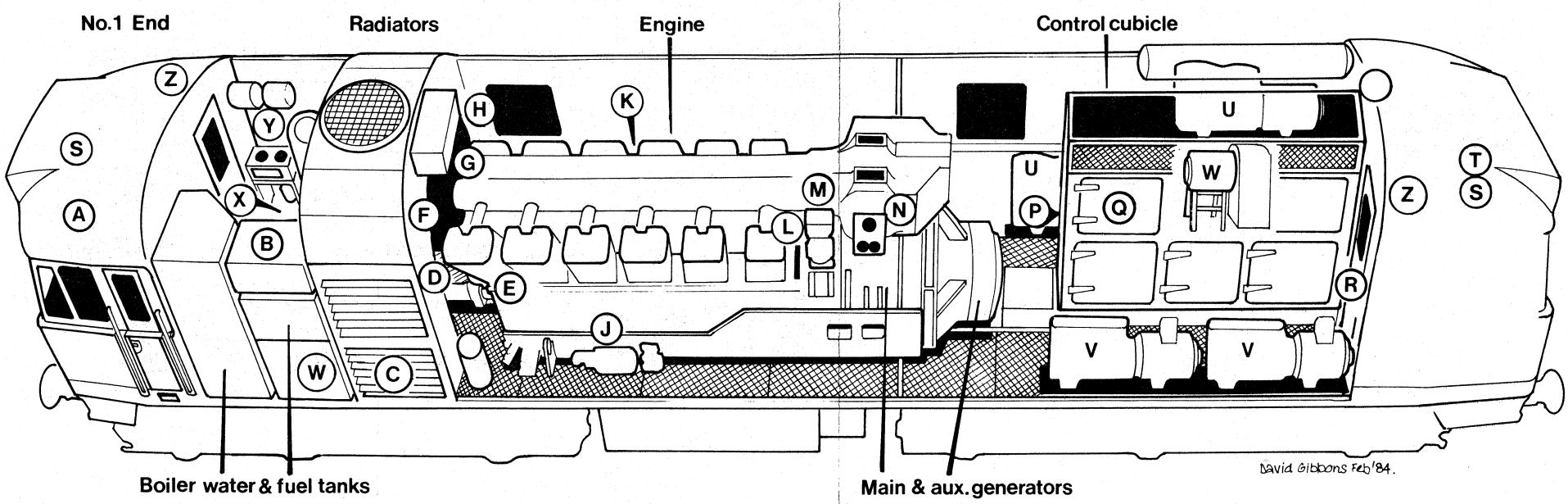
Interior

1 Train heating boiler, if fitted
2 Radiator fan
3 Radiator panel
4 Radiator fan drive from engine
5 English Electric 1470 bhp V-12 diesel engine (12 SVT)
6 Turbo-charger (one of two)
7 Engine exhaust
8 Main generator,Brush TG 160,48
9 Auxiliary generator, Brush TG 69.42
10 Control cubicle (electrical switchgear)
11 Traction motor blower (one of two) behind control cubicle
12 Driver's seat

Exterior

13 Commonwealth cast steel bogie frame
14 Equalising beam
15 Secondary suspension leaf springs
16 Primary suspension coil springs
17 Brake cylinder, one of four on each bogie
18 Battery box (both sides)
19 Underslung fuel tank, capacity 530 gallons
20 Fuel level sight glass
21 Axle spur gear
22 Traction motor pinion
23 Non-powered axle
24 Traction motor (one of four) Brush TM 73.68
25 Traction motor drive gearcase

Fig.2 Interior



KEY TO LETTERS

A DSD isolating cock No.1 end DB
B Emergency fuel tank
C Radiator shutters
D Compressor governor & isolating cock
E Engine overspeed device
F Radiator arch
At floor level below:
A side – DSD air isolating cock VB
B side – DSD vac. isolating cock VB
Main res. isolating cock DB

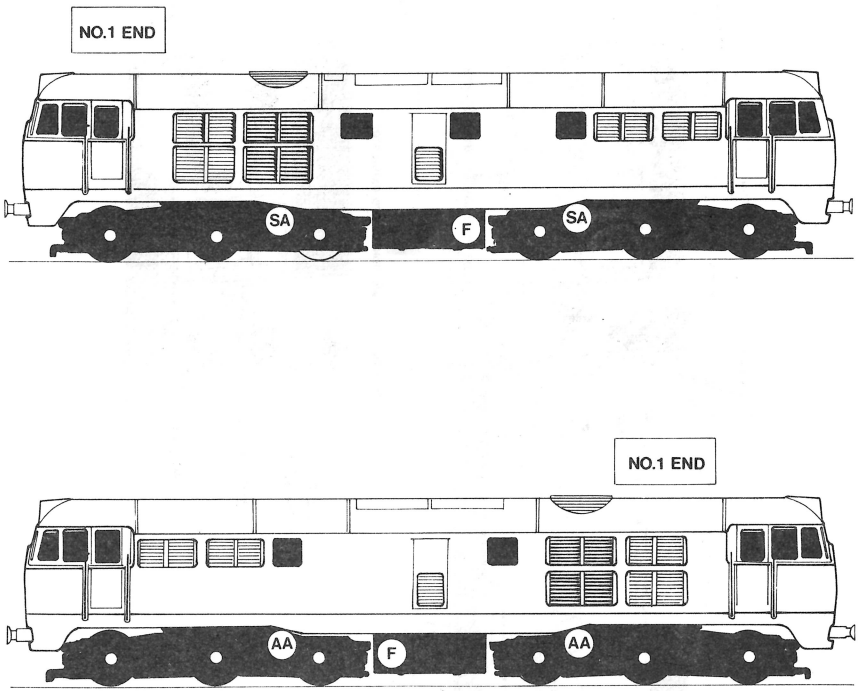
G Radiator header tank gauge
H Control circuit governor, various locations ETS
J Fuel transfer pump
K Engine lub. oil dipstick on crankcase
L Fuel rack
Manual over-ride lever
M Engine speed governor
N Engine instrument panel
Indicates oil pressure, charge air pressure, turbo charger 1 & 2

P Front face of cubicle:
Fault lights, switches & BIS below
Q Fuse & mcb panel
R Control air pressure gauge
S Exhauster speed-up governor DB
T Brake pipe governor No.2 end only DB
U Compressors behind control cubicle
V Exhausters 1 & 2 (No.2 at No.2 end)
W Traction motor blower (behind control cubicle at No.2 end)

X Loco. distributor isolating cock DB
Proportional valve VB
Y Distributor control air release DB
Vacuum chamber release VB
Z Vacuum chamber release DB
(on rear cab wall)

DB Dual-braked loco. VB Vac. braked loco. ETS Loco with ETS

Fig.3 External Equipment



SA Straight air brake isolating cock AA Automatic air brake isolating cock

F Fuel tank level sight glass
(Engine fuel only).

These cocks located under side framing above bogie in position shown.

Fig.4 Interior (with ETS)

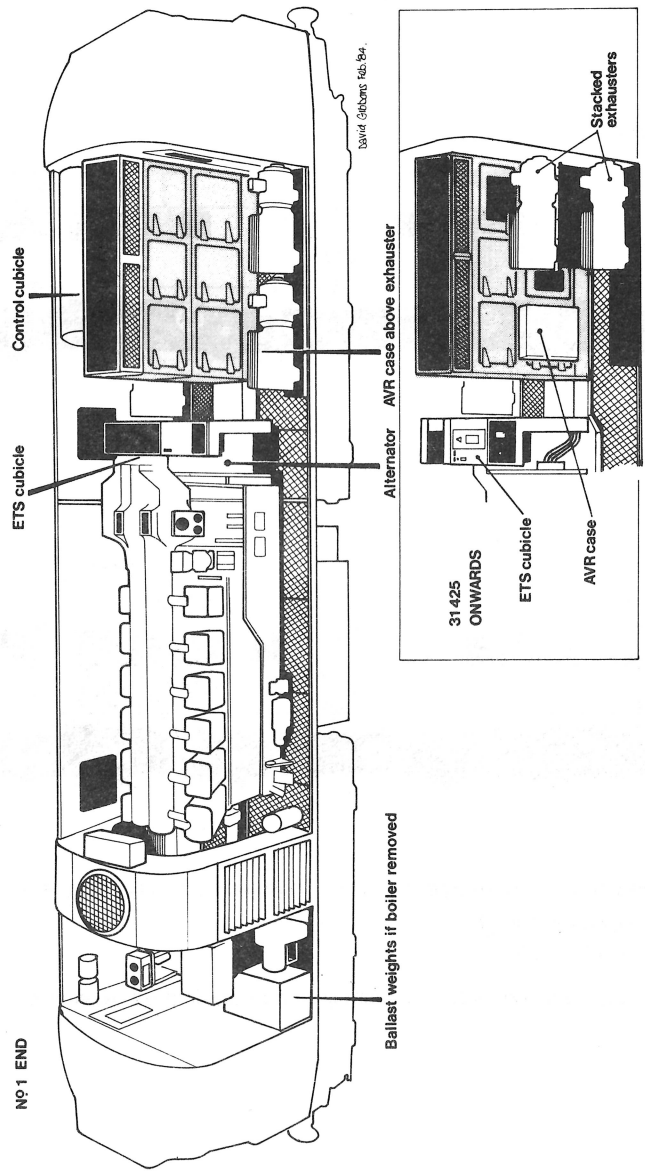
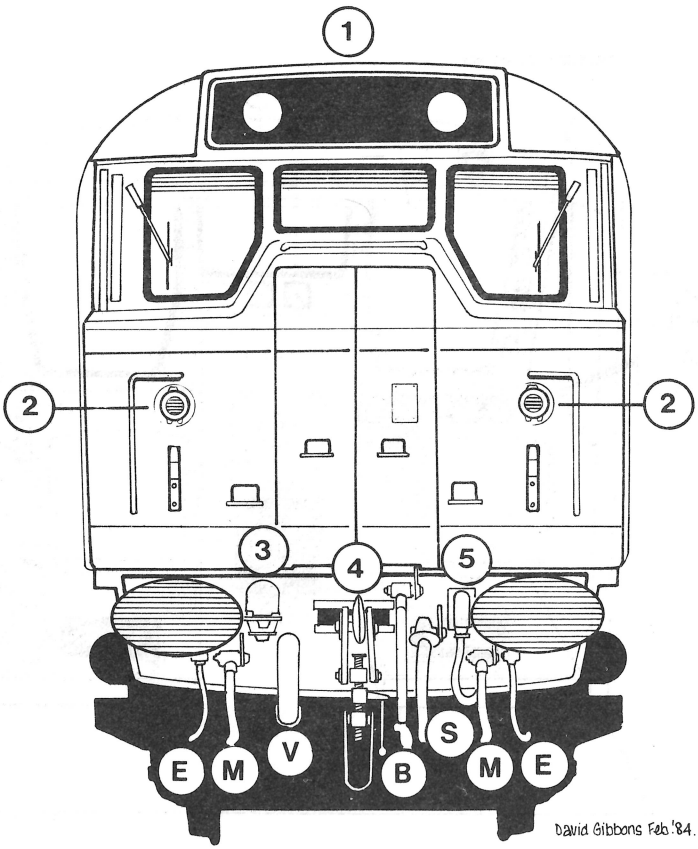


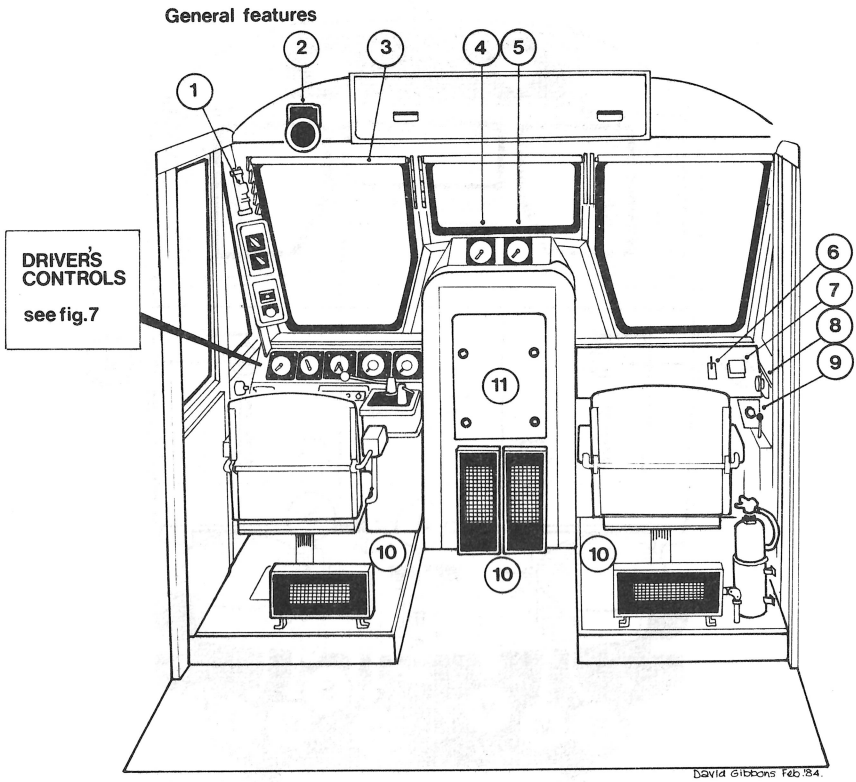
Fig.5 Front End
Dual brake, boiler fitted



1 Marker light
2 Tail lights
3 Jumper cable receptacle
4 Drawhook and screw coupling
5 Jumper cable, multiple working (blue star)

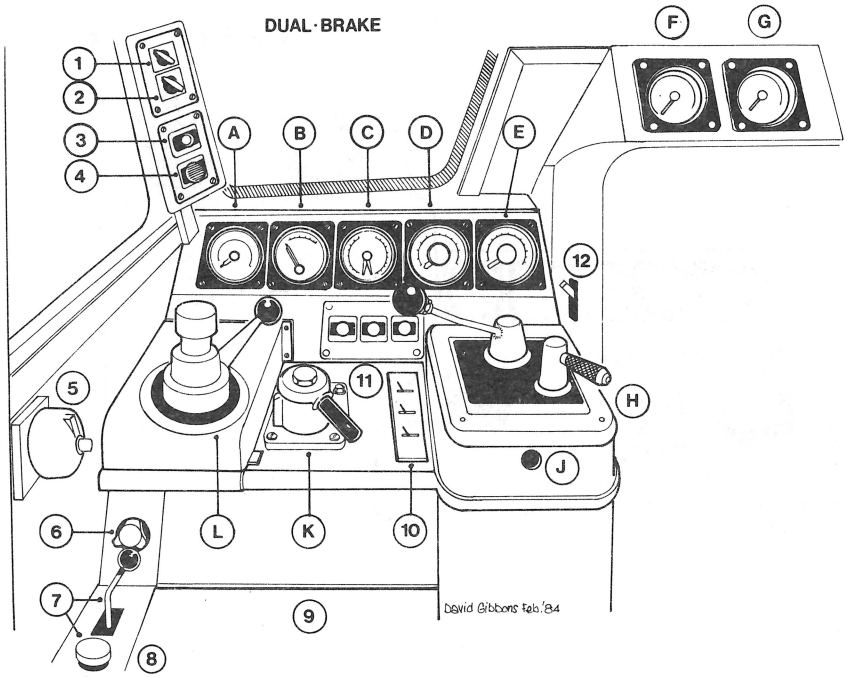
E Engine control air pipe
M Main reservoir pipe
V Vacuum brake pipe
B Brake pipe, automatic air brake
S Steam pipe

Fig.6 Driving Compartment
General features

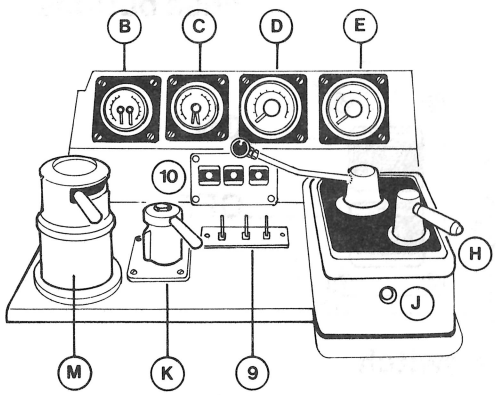


1 Windscreen wiper air motor
2 AWS indicator
3 Sun visor
4 Main reservoir pressure gauge
5 Boiler steam pressure gauge
6 Boiler emergency shut-down switch
7 Boiler alarm light
8 DSD holdover button
9 Windscreen wiper/washer control and horn valve
10 Heaters
11 Access panel

Fig.7 Driver's Controls



VACUUM BRAKE



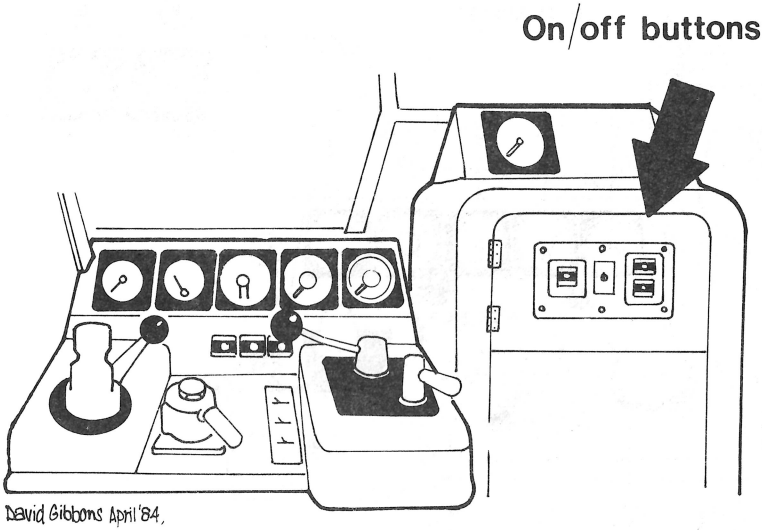
INSTRUMENTS & MAIN CONTROLS

A Brake pipe pressure
B Duplex brake cylinder pressure
C Vacuum chamber & train pipe
D Main generator amps
E Speedometer
F Main reservoir pressure
G Steam pressure, train heat boiler
H Master switch & power controller
J Master key insert
K Straight air brake valve
L Automatic air brake valve
M Vacuum brake valve

OTHER CONTROLS

1 Instrument light switch
2 Cab lights switch
3 Engine start button
4 Engine stop button
5 AWS reset button
6 Screen wiper control
7 Screen washer control & horn
8 Horn isolating cock
9 DSD pedal & sander pedal on floor
10 Switches for demister & foor warmer
11 Warning lights
12 Alternative screen washer switch position on some loco's.

Fig.8 Train Supply



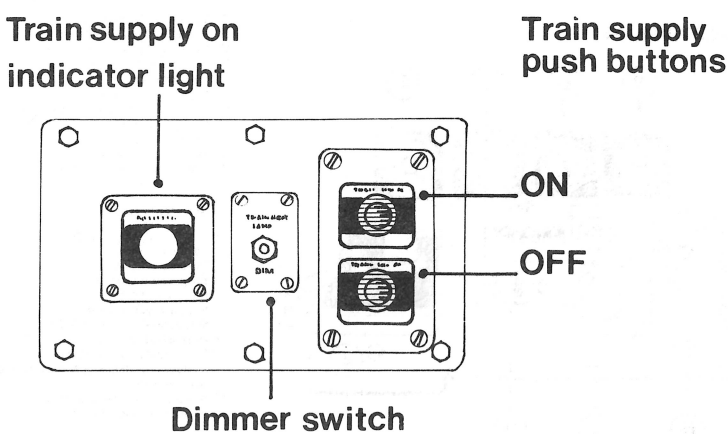
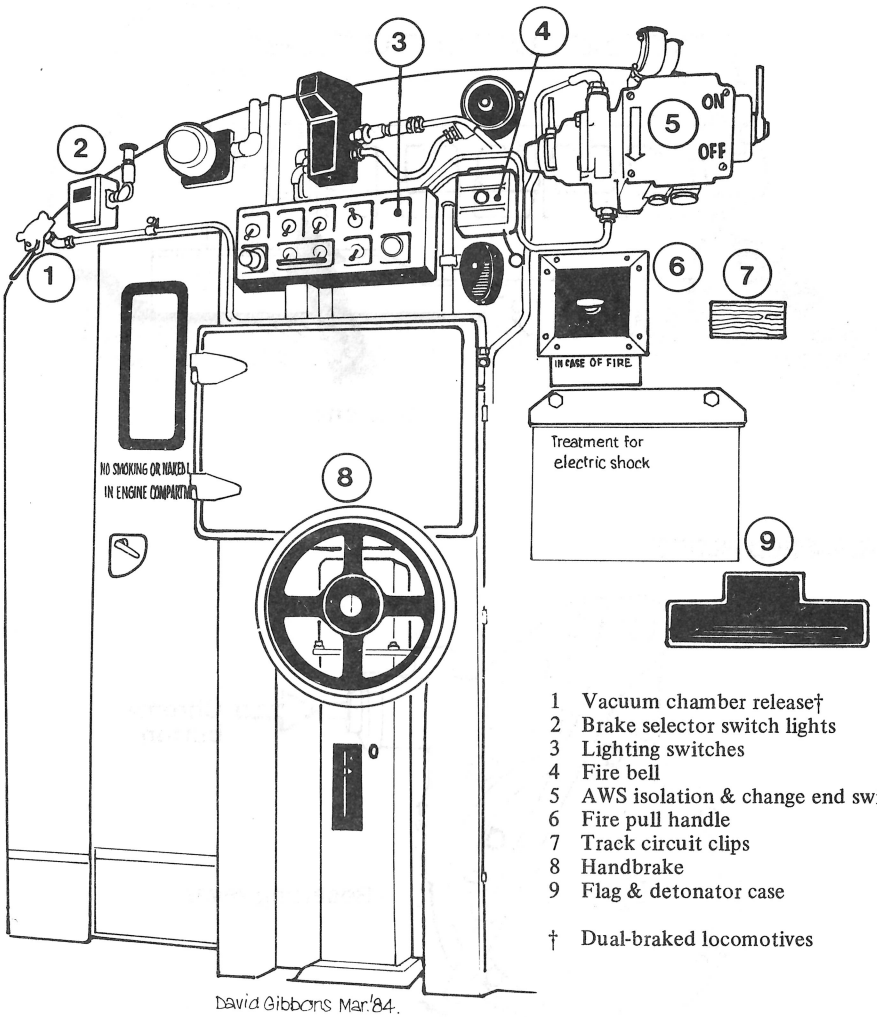


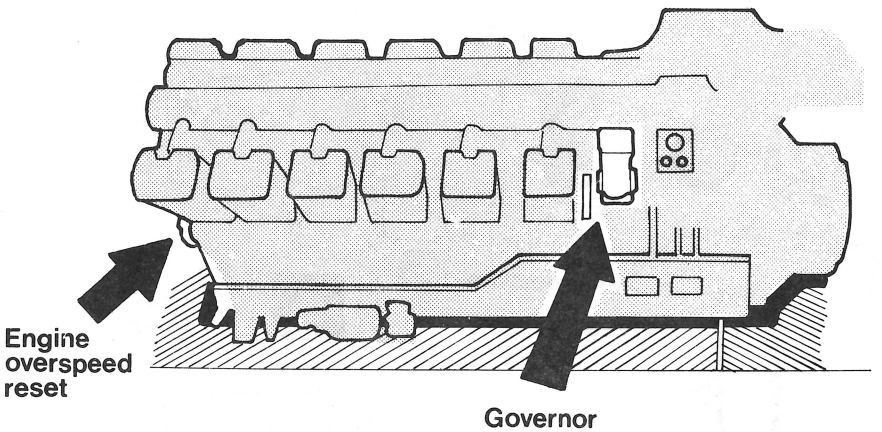
Fig.9 Driving Compartment
Rear bulkhead No.2 end



1 Vacuum chamber release†
2 Brake selector switch lights
3 Lighting switches
4 Fire bell
5 AWS isolation & change end switch
6 Fire pull handle
7 Track circuit clips
8 Handbrake
9 Flag & detonator case

† Dual-braked locomotives

Fig.10 Engine Overspeed Reset and Woodward Governor



OVERSPEED RESET

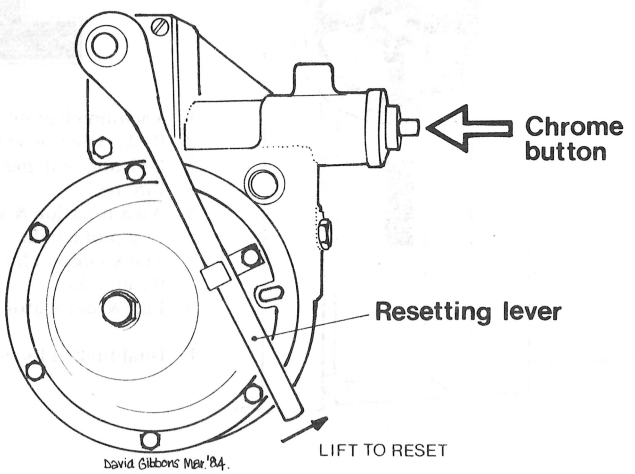


Fig.11 Governor

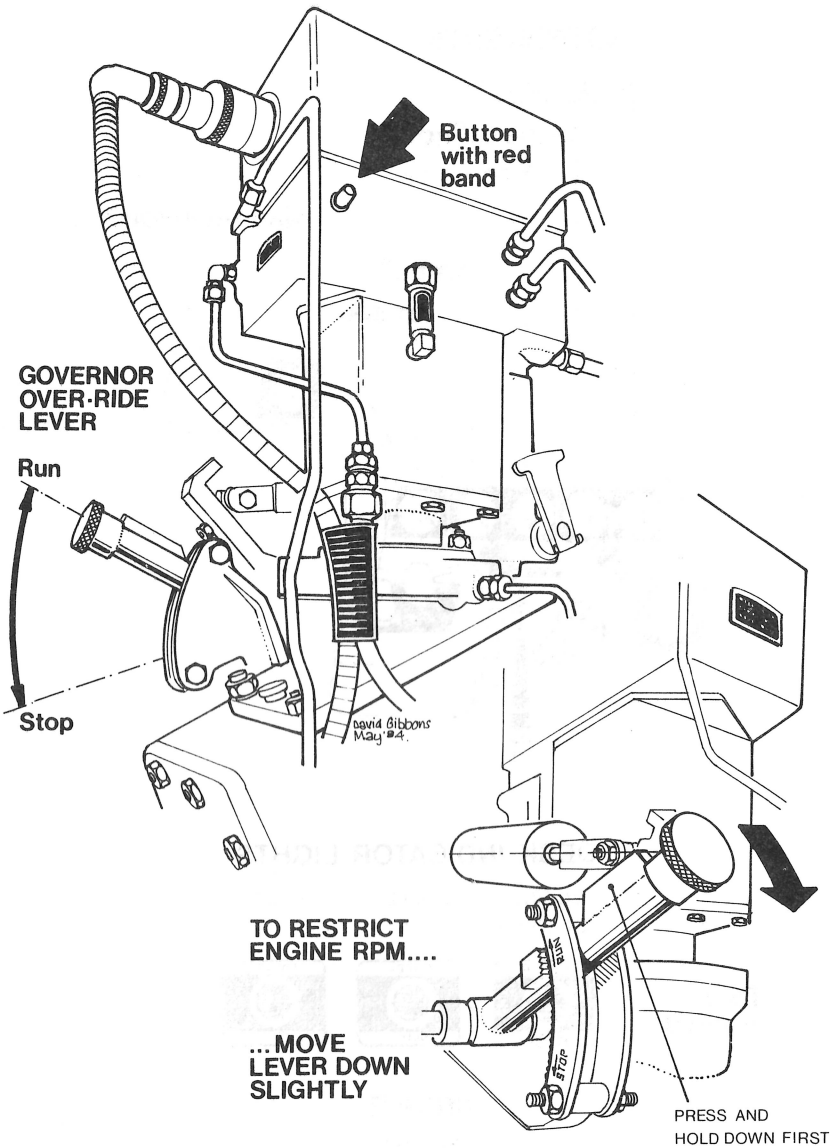
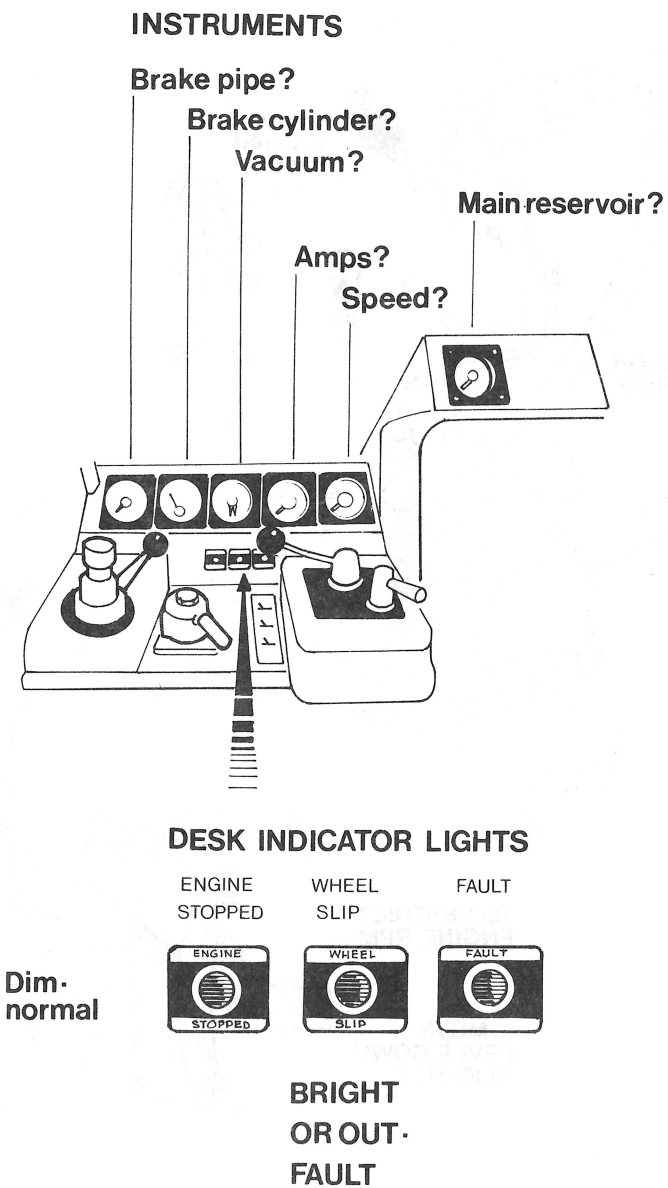


Fig.12 Faults: Check List



PART A – LOCOMOTIVES WHICH HAVE NOT BEEN REFURBISHED.

These may be readily identified by the knife type battery isolating switch and exhauster isolation switches in the BIS compartment and the absence of circuit breakers at the end of the control cubicle.

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	7.	Blue 'general fault' indicator light BRIGHT when power controller is open, remains BRIGHT when controller is closed – No loss of traction power.	28
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	9.	Partial loss of traction power/locomotive does not develop full power – Desk indicator lights normal – all DIM.	30

THE FOLLOWING FAULTS APPLY TO CLASS 31/4 LOCOMOTIVES ONLY – WHEN AN ELECTRIC TRAIN SUPPLY (ETS) IS TO BE PROVIDED.

10. Electric Train Supply (ETS) indicator light does not illuminate when the ON button is pressed. 30

11. Electric Train Supply (ETS) indicator is extinguished when ON button is released. 31

12. Electric Train Supply (ETS) indicator light is extinguished whilst running. 31

13. Electric Train Supply (ETS) indicator light is extinguished whilst running – Blue 'general alarm' indicator light BRIGHT. 32

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1. WARNING AND OTHER INDICATIONS.

The usual indications are provided:

1.1 In the driving compartments – Three indicator lights on the driving desk which are DIM when normal or BRIGHT (or EXTINGUISHED) when there is a fault condition.

Red BRIGHT	–	diesel engine stopped/running
Yellow BRIGHT	–	Wheelslip, or fault developing in a traction motor or its associated circuitry.
Blue BRIGHT	–	general fault indication (refer to subsidiary panel as necessary)

In addition there is a white indicator light on Class 31/4 locomotives which, when illuminated, shows that an Electric Train Supply (ETS) has been established.

1.2 At No.2 end of the locomotive – Five further indicator lights on a subsidiary panel on the front of the main control cubicle. These are in vertical pairs which are illuminated GREEN (top) when the particular condition is normal, or RED (bottom) where there is a fault condition (see page 33).

Traction Motor Blowers	–	RED when a traction motor blower has failed.
Fuel	–	RED when the level in the emergency tank falls to a pre-determined figure i.e. 42 galls sufficient for, say, 30 miles running.
Water Temperature	–	RED when engine coolant temperature has risen to 195°F.
Water Level	–	RED when the level in the coolant header tank falls to a pre-determined point, whereupon the diesel engine will automatically shut down.
Earth	–	RED when either a power earth fault or auxiliary earth fault occurs.

In all cases illumination of the RED indicator light on the subsidiary panel will be drawn to the Drivers' attention by the BRIGHTENING of the BLUE 'general fault' indicator light on the driving desk.

1.3 Within the main control cubicle – a 'flagged' Power Earth Fault Relay (PEFR) and Auxiliary Earth Fault Relay (AEFR) – see page 35.

1.4 In the driving compartments of dual-braked locomotives only – Four repeater lights to show the position of the brake selector switch:

vacuum passenger	vacuum goods
air passenger	air goods

2. FUSES AND THE EFFECT OF THEIR RUPTURING IN SERVICE.

Located on fuse panel within main control cubicle at No.2 end – see page 35.

2.1 Cooker/hotplate (where provided) 20 amp – facility not available

2.2 Cab heaters No.1 cab & No.2 cab 30 amp – facility not available

2.3 Boiler (where fitted) 2 x 40 amp – boiler not operable

2.4 Battery Charge 100 amp – Battery charging will cease. If the engine is subsequently stopped for any reason it will not be possible to restart it and the lub. oil priming pump will not run. If the Fuel Transfer Pump Isolating Switch (FTIS) is moved to TEST the pump will not run when the battery charge fuse is ruptured.

2.5 Compressor(s) 2 x 100 amp – DUAL BRAKED LOCOMOTIVES ONLY. The associated compressor i.e. No.1 or No.2 will stop. If either fuse ruptures the time taken to charge the air system will be excessive and if both rupture air pressure will be lost and a brake application will be initiated when main reservoir pressure falls to 65 p.s.i.

2.6 Blower motors 2 x 100 amp – The associated traction motor blower i.e. No.1 or No.2 will stop.

3. **FUSE CHANGING PROCEDURE – When practicable.**

3.1 Stop the diesel engine.

3.2 Open the battery isolating switch.

3.3 Remove the suspected fuse.

3.4 Place suspect fuse on the fuse tester, if it is NOT ruptured the adjacent lamp will illuminate. If the lamp does not illuminate then fuse has ruptured.

3.5 Test a replacement fuse of the correct amperage and position it securely.

NOTE: Where two ratings are listed in Section 2 e.g. 30/32 amp either value may be used as a replacement.

3.6 Close the battery isolating switch.

3.7 Restart the diesel engine and proceed.

NOTE: 1. ONLY ONE SPARE FUSE SHOULD BE USED, IF THIS RUPTURES THE ASSOCIATED CIRCUITRY IS DEFECTIVE AND CANNOT BE USED.

2. ON THESE LOCOMOTIVES THE FUSE TESTER IS ON THE LIGHTING CIRCUIT AND IS THEREFORE AVAILABLE WITH THE BATTERY ISOLATING SWITCH 'OPEN'.

4. **MINIATURE CIRCUIT BREAKERS AND THE EFFECT OF THEIR TRIPPING IN SERVICE.** **(see page 35).**

4.1	Control Circuit Breaker	– The AWS warning indication will sound and cannot be reset, brake application will be initiated. Desk and subsidiary indicator lights extinguished.
4.2	Driving lights MCB	– Marker lights extinguished.
4.3	Maintenance lights MCB	– Driving compartment and engine room lighting extinguished.

5. LOCOMOTIVES MODIFIED TO PROVIDE AN ELECTRIC TRAIN SUPPLY (ETS).

Certain locomotives have been so modified, in two batches, and renumbered into the 314XX series i.e. 31401 to 31424 and 31425 to 31468.

All locomotives in the range 31425 to 31468 will be refurbished as they are converted to provide an ETS and are dealt with in PART B of this publication.

Locomotives in the range 31401 to 31424 will be refurbished at their next classified repair to bring them to the same condition as those in the range 31425 to 31468.

The following information applies only to 31401 to 31424 prior to refurbishing.

5.1 The former auxiliary generator has been replaced by an alternator which has two separate 3-phase output windings, which are rectified to give 2 d.c. outputs, one at 110 volts for the auxiliary machines such as exhausters and compressors and the other at 825 volts for the ETS.

Both the auxiliary and ETS outputs are protected by thermal overload devices which contain an alloy that melts should the current passing through the device become excessive. Once the device has operated to cut off the current then at least 60 seconds must be allowed to elapse to allow the alloy to re-solidify before attempting to reset the overload device by means of the appropriate reset button.

There are two auxiliary overload devices AOL1 and AOL2 – if either operate there will be loss of both traction and ETS supply – SEE FAULT 5b.

There are also two 'train heat' overload devices THOL1 and THOL2 which, because of manufacturing tolerances, will operate at slightly different excess current values, thereby enabling a fault on the train to be detected by THOL1 or THOL2 which immediately opens the train supply contactors to cut off the ETS – SEE FAULT 11b.

If however the fault still persists i.e. it is within the locomotive circuitry between the ETS output winding and the now-open train supply contractors, then THOL1 and THOL2 will operate to 'trip' the Diode Failure Relay (DFR) which immediately stops the diesel engine. – see Fault 2a.

If an auxiliary or ETS rectifier diode fails this will be detected by Rectifier Fault Relays (RFR) which will operate to 'trip' the Diode

Failure Relay (DFR) which immediately stops the diesel engine – see Fault 2b.

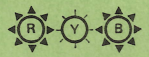
5.2 The train supply control circuits are protected by a Train Heat Control Circuit Breaker (THCCB). If this 'trips' the ETS will be lost – see Fault 12a.

5.3 The auxiliary supply is protected from a malfunction of the Automatic Voltage Regulator (AVR) by a circuit breaker which, if it 'trips', will cause loss of traction power - see Fault 5a.

5.4 Located on the ETS cubicle are two lights labelled TRAIN HEAT EARTH FAULT INDICATORS. They are illuminated whenever there is an output from the train heat alternator, whether ETS has been established or not. They are provided to enable maintenance staff to undertake earth tests on the ETS.

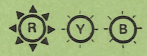
6. FAULT FINDING CHARTS

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
1. Engine STOPS Red 'engine stopped' indicator light BRIGHT 	a. Engine overspeed	–	Check engine overspeed device on free end of diesel engine. If 'tripped' i.e. chrome button not protruding then reset. If device trips again immediately on restarting the engine – request assistance. If device trips again when full power is restored reset ONCE MORE and use manual over-ride control handle at drive end of engine to restrict engine r.p.m. If device trips again – request assistance.
	b. Low lub. oil pressure (below 20/22 psi at idling rpm or below 33/36 psi at full rpm)	–	Check red-banded button on diesel engine ('Woodward') governor. If this is protruding then check oil level in sump. If above MAX on dipstick DO NOT ATTEMPT to restart engine (fuel dilution) – request assistance. If between MAX and MIN reset the button on governor and attempt to restart the engine. If oil pressure rises to above 20/22 psi then engine will continue to run when start button is released. If engine does not run and red-banded button again protrudes, or level is below MIN, request assistance.
	c. Fuel starvation (Main fuel tank empty)	–	Move Fuel Transfer Pump Isolating Switch to OFF and restart engine. NOTE: automatic changeover to gravity feed was prevented by air pressure on fuel system non return valve.

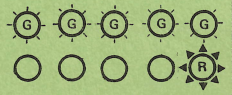
INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
2. Engine STOPS Red 'engine stopped' indicator light BRIGHT Blue 'general fault' indicator light BRIGHT 	a. **CLASS 31/4 ETS LOCOMOTIVES ONLY** Train Heat Overload (THOL1 & THOL2) protective devices & Diode Failure Relay (DFR) all tripped	–	Press THOL reset button on r.h.s. of ETS cubicle NOTE: At least 60 seconds must have elapsed from engine shutting down until reset button is pressed. Reset DFR adjacent to THOL reset button and attempt to restart engine. If DFR trips again request assistance. DRIVERS MAY ATTEMPT TO RESET DFR ONCE ONLY. **OPEN B.I.S. BEFORE ENTERING ETS CUBICLE.**
	b. **CLASS 31/4 ETS LOCOMOTIVES ONLY** Diode Failure Relay (DFR)	–	Reset DFR and attempt to restart engine. If DFR trips again request assistance. DRIVERS MAY ATTEMPT TO RESET DFR ONCE ONLY. **OPEN B.I.S. BEFORE ENTERING CONTROL CUBICLE.**
	c. Low water level	Water level indicator light RED 	Check water level gauge on header tank and check system for leakage. If level is low and arrangements cannot be made to top-up the system then request assistance.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
3. AWS warning sounds and will not reset. brake application Desk indicator lights EXTINGUISHED ○ ○ ○	a. Control circuit breaker tripped	All extinguished ○ ○ ○ ○ ○ ○ ○ ○ ○ ○	Check control circuit breaker at control cubicle at No.2 end. Attempt to reset, if CCB trips again move earth isolating switch to AUXILIARIES and again try to reset. THERE MUST BE NO MORE THAN THREE ATTEMPTS TO RESET CCB.
4. Complete loss of traction power Brake application Desk indicator lights normal – all DIM (R) (Y) (B)	a. **DUAL BRAKED LOCOMOTIVES ONLY** Loss of main reservoir pressure (below 65 psi) NOTE: The low main reservoir pressure feature of the brake application unit will vent the air brake pipe	–	Check compressors – if NOT running check compressor governor on l.h.s. of engineroom at free end of engine, toggle should be 'up'. If still not running check compressor fuses at control cubicle at No.2 end. NOTE: On a dual braked locomotive, running under vacuum conditions, move compressor change-over switch to CHANGEOVER to bring in the other compressor. Change fuse later when convenient. If compressors ARE running check systems for leakage – particularly drain cocks, flexible hoses etc. If working two pipe air braked train close cocks between locomotive and train to identify location of loss.

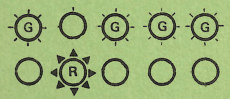
INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
4. Complete loss of traction power Brake application Desk indicator lights normal – all DIM (Continued)	b. Loss of train pipe vacuum (below 12½ ins.)	–	Check exhausters – If NOT running check that exhauster isolating switches at control cubicle are fully closed. If exhausters ARE running check system for leakage, particularly flexible hoses. Part hoses between locomotive and train to identify location. e.g. could be passenger communication valve operated. NOTE: On vacuum braked only locomotives isolate AWS and DSD equipment in turn (DSD air isolating cock under radiator arch 'A' side at floor level and DSD vacuum isolating cock at floor level on 'B' side of radiator arch). Check if vacuum brake pipe is regained after each isolation.
	c. **DUAL BRAKED LOCOMOTIVES ONLY** Loss of air brake pipe pressure (below 49 psi) (main reservoir pressure adequate – above 95 psi)		Check main reservoir pressure is above 95 psi. Isolate AWS and DSD equipment in turn (DSD isolating cock on No.1 nose end) and check if brake pipe pressure is regained after each isolation. If still unable to regain pressure examine flexible hoses and cocks. Close cocks between locomotive and air braked train to identify location of loss e.g. could be passenger communication valve operated.

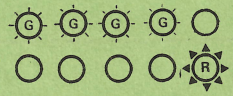
INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
5. **CLASS 31/4 ETS LOCOMOTIVES 31401 to 31424 ONLY** Complete loss of traction power Red 'engine stopped' indicator light BRIGHT **Engine continues running** 	a. Auxiliary supply protection circuit operated	–	Check Automatic Voltage Regulator (AVR) on bodyside at No.2 end near vacuum exhausters. AVR will be fitted with either (a) a circuit breaker, which will be 'down' if tripped. Attempt to reset to regain traction power, or (b) an AVR TRIPPED warning light – if illuminated press the AVR reset button to attempt to regain traction power. NOTE: ONLY THREE ATTEMPTS TO RESTORE AUXILIARY SUPPLY ARE PERMITTED. If auxiliary supply cannot be restored request assistance.
	b. Auxiliary Overload (AOL1 & AOL2) protection device tripped	–	Press AOL reset button on r.h.s. on ETS cubicle, NOTE: At least 60 seconds must have elapsed from loss of traction (and ETS) power until reset button is pressed. If traction power cannot be regained i.e. AOL will not reset then request assistance.
	c. ETS control cubicle doors not properly closed.	–	Check all control cubicle doors and ensure that all budget locks are correctly engaged.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
6. Complete loss of traction power Blue 'general fault' indicator light BRIGHT when power controller is open, DIM when closed. 	a. **VACUUM BRAKED ONLY LOCOMOTIVES** Loss of main reservoir pressure (below 55 psi) or Control circuit Governor (CCG) defective		Check compressor, if NOT running check compressor governor at free end of engine 'B' side by radiator arch, toggle should be 'up'. If compressor IS running check system for leakage, particularly drain cocks, flexible hoses etc. Check toggle of CCG at free end of engine 'A' side by radiator arch – toggle should be 'up'.
	b. Loss of control air pressure (below 49 psi) or Control Circuit Governor (CCG) defective		Check control air pressure gauge on bulkhead at No.2 end, normally reads approx. 70 psi. Check that control air isolating cocks near the exhauster at No.2 end are fully open and that the control reservoir drain cock, behind buffer beam at No.2 end, is fully closed. Check CCG by radiator arch (non ETS locos) or No.2 end bulkhead (ETS locos), toggle should be 'up'.
	c. **IN VACUUM CONDITIONS** Vacuum control Governor (VCG) defective (possibly after a brake application)		Check VCG on bulkhead at No.2 end, toggle should be 'down'. NOTE: VCG should close as vacuum brake pipe rises to 15 ins.
	d. **DUAL BRAKED LOCOMOTIVES ONLY.** Brake pipe Governor (BPG) (possibly after a brake application)		Check BPG in No.2 nose end, toggle should be 'up'. NOTE: BPG should close as air brake pipe rises to 62 psi.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
6. Complete loss of traction power etc. (Continued)	e. Power Earth Fault Relay (PEFR) tripped	Earth indicator light RED 	Manually reset PEFR at control cubicle. IF PEFR trips again move earth isolating switch to POWER and reset PEFR. If traction power is regained then proceed but request fresh locomotive at first convenient point. If PEFR still trips request assistance. **NOTE: STOP ENGINE & OPEN BIS BEFORE ENTERING CONTROL CUBICLE.** If, when traction power is regained, the YELLOW wheelslip light is BRIGHT then suspect defective traction motor. Examine traction motors for signs of overheating and, if evident, isolate the appropriate pair by the switch at the control cubicle. If there is no evidence find defective pair by trial and error. **NOTES** 1. If isolation of traction motors has been necessary then arrange for check of axle rotation before continuing. 2. Field diversion will be suspended when traction motors are isolated. 3. With traction motors isolated max. amps NOT to exceed: 1000 for brief periods (not exceeding one minute) when starting away. 850 during acceleration. 600 continuous whilst running.
	f. Load regulator has not run back to MINIMUM position. (possibly after a stop or period of coasting).	–	Check load regulator, if not at MINIMUM i.e. left hand end of its travel then STOP THE ENGINE and open the B.I.S. Using the small handle at the end of the regulator turn it back to MINIMUM, making sure that the contact clips home. Close the B.I.S. restart the engine and proceed.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
6. Complete loss of traction power etc. (Continued)	g. Traction motor overload	–	Close power controller. Wait 15 seconds to ensure that load regulator runs back to MINIMUM and then reopen controller. If power is regained then proceed but report the operation of traction motor overloads or tripping of PEFR as necessary. If, when power is regained, the YELLOW wheel-slip light is BRIGHT then suspect a defective traction motor. Examine traction motors for signs of overheating and, if evident, isolate the appropriate pair by the switch at the control cubicle. If there is no evidence find the defective pair by trial and error. **NOTES** 1. If isolation of traction motors has been necessary then arrange for check of axle rotation before continuing. 2. Field diversion will be suspended when traction motors are isolated. 3. With traction motors isolated max. amps NOT to exceed: 1000 for brief periods (not exceeding one minute) when starting away. 850 during acceleration. 600 continuous whilst running.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
7. Blue 'general fault' indicator light BRIGHT when power controller is open, remains BRIGHT when controller is closed. No loss of traction power.	a. High water temperature (above 195°F)	High water temperature indicator light RED	Reduce power to notch 2 when possible and, if blue 'general fault' indicator light then dims, proceed. When convenient check that radiator shutters are fully open (levers are situated on either side at free end of engine) and water level gauge on header tank. If level is getting low and arrangements cannot be made to top-up the system, or there is evidence of leakage, then clear running lines and request assistance as necessary.
	b. Low fuel level (possibly only some 42 galls remaining)	Low fuel level indicator light RED 	At first convenient point check main and emergency tank gauges, if main tank shows EMPTY and emergency tank shows approx. 42 galls with fuel transfer pump still running, then 'low fuel' indication is correct. There is sufficient fuel for approx. 30 miles running-move Fuel Transfer Pump Isolating Switch (F.T.I.S.) to OFF and arrange to clear running lines/obtain fuel/ request assistance as necessary. If main tank shows adequate contents check if fuel transfer pump is running. If NOT turn FTIS to TEST. If pump still does not run check battery charge fuse. If pump still does not run i.e. fuse has not ruptured then move FTIS to OFF – fuel transfer pump has failed, leaving sufficient fuel for approx. 30 miles running. Arrange to clear running lines/ request assistance as necessary.
	c. Traction motor blower stopped	Traction motor blower indicator light RED	Reduce power to notch 2 when possible and, at first convenient point, check which blower has stopped and if either fuse is ruptured then change. If replacement fuse also ruptures, or fuses are sound and blower still does not run, then proceed keeping power as low as possible and request assistance as necessary.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
	d. Auxiliary earth fault	Earth indicator light RED 	Move Earth Isolating Switch (E.I.S.) to AUXILIARIES ISOLATED and report this in the repair book. Reset Auxiliary Earth Fault Relay (AEFR) within control cubicle as soon as possible to 'dim' the general fault indicator light. **NOTE: STOP ENGINE & OPEN BIS BEFORE ENTERING CONTROL CUBICLE.**
8. Partial loss of traction power Yellow 'wheelslip' indicator light BRIGHT	a. Wheelslip	–	Ease power controller to a position at which the wheelslip light remains DIM. If rail conditions are very poor then close controller, apply sand and reopen controller slowly.
	b. Traction motor fault developing	–	If wheelslip light is BRIGHT and it is evident that there is no wheelslip, then stop at first convenient point and examine traction motors for signs of overheating etc. If evident isolate the appropriate pair by the switch at the control cubicle. If there is no evidence find defective pair by trial and error i.e. yellow wheelslip light remains DIM when controller is opened. **NOTES:** 1. Arrange for check of axle rotation before continuing. 2. Field diversion will be suspended when traction motors are isolated. 3. With traction motors isolated max. amps NOT to exceed: 1000 for brief periods (not exceeding on minute) when starting away. 850 during acceleration. 600 continuous whilst running.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
9. Partial loss of traction power/locomotive does not develop full power Desk indicator lights normal – all DIM 	a. Fuel racks not fully open	–	When convenient check that manual over-ride control handle at drive end of engine is fully at the TOP of the quadrant.
	b. Loss of regulating air pressure	–	When convenient check system e.g. flexible hoses, cocks, connections to governor, master switch away from OFF in unoccupied driving compartment (with or without a master key in position), etc. etc.
	c. Traction motors isolated (by a previous person)	–	Check isolating switch on end of control cubicle when convenient. If no appropriate entry in the repair book de-isolate. Report facts in repair book as appropriate.
	d. Charging air pressure low	–	When practicable check charging air pressure gauges which should indicate 5 psi when power controller is fully open.
10. **CLASS 31/4 LOCOMOTIVES ONLY.** Electric Train Supply (ETS) indicator light does not illuminate when the ON button is pressed.	a. Lamp defective in indicator light	–	Check indicator light in the other driving compartment.
	b. Train Heat Control Circuit Breaker (THCCB) tripped	–	Check THCCB on l.h. side of E.T.S. cubicle, should be 'down' for ON. If tripped attempt to reset and establish ETS not more than three times. If THCCB will not reset then locomotive is unable to provide ETS, advise Guard/Station Staff accordingly.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
11. **CLASS 31/4 LOCOMOTIVES ONLY** Electric Train Supply (ETS) indicator light is extinguished when ON button is released.	a. ETS jumper cables not correctly coupled or not correctly stored in dummy sockets.	–	Check locomotive and advise Guard/Station Staff accordingly. Arrange for ETS jumper cables to be uncoupled between locomotive and train as necessary to establish where fault lies.
	b. Train Heat Overload (THOL1 & THOL2) protection	–	Press reset button on the r.h. side of ETS cubicle and attempt to establish ETS. If ETS not available then advise Guard/Station Staff accordingly.
12. **CLASS 31/4 LOCOMOTIVES ONLY** Electric Train Supply (ETS) indicator light is extinguished whilst running	a. Train Heat Control Circuit Breaker (THCCB) tripped	–	Check THCCB on l.h. side of ETS cubicle, should be 'down' for ON. If tripped attempt to reset and re-establish ETS not more than three times. If THCCB will not reset advise Guard/Station Staff accordingly.
	b. Train Heat Overload (THOL1 & THOL2) protection device tripped	–	Press THOL reset button on r.h. side of ETS cubicle and attempt to re-establish ETS. If unable to do so advise Guard/Station Staff accordingly.
	c. ETS jumper cable uncoupled or not	–	Check locomotive at first convenient point and advise Guard/Station Staff accordingly.
	d. Lamp defective in indicator light	–	Check indicator light in other driving compartment when convenient.

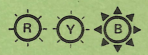
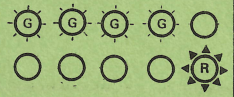
INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
13. **CLASS 31/4 LOCOMOTIVES ONLY** Electric Train Supply (ETS) indicator light is extinguished whilst running Blue 'general fault' indicator light BRIGHT 	a. Train Supply Earth Fault		Electric train supply not available – advise Guard/Station Staff accordingly. To clear the 'general fault' indication STOP THE ENGINE & OPEN B.I.S. before entering the ETS cubicle to reset Train Heat Earth Fault Relay 2 (THEFR2) – see fig.16 page 36. **NOTE.** When a particular locomotive is fitted with earth fault indicators on the ETS cubicle (see fig.16 page 36) then THEFR2 is replaced by the Diode Failure Relay (DFR) – see Fault 2.

Fig.13 Control Cubicle 1

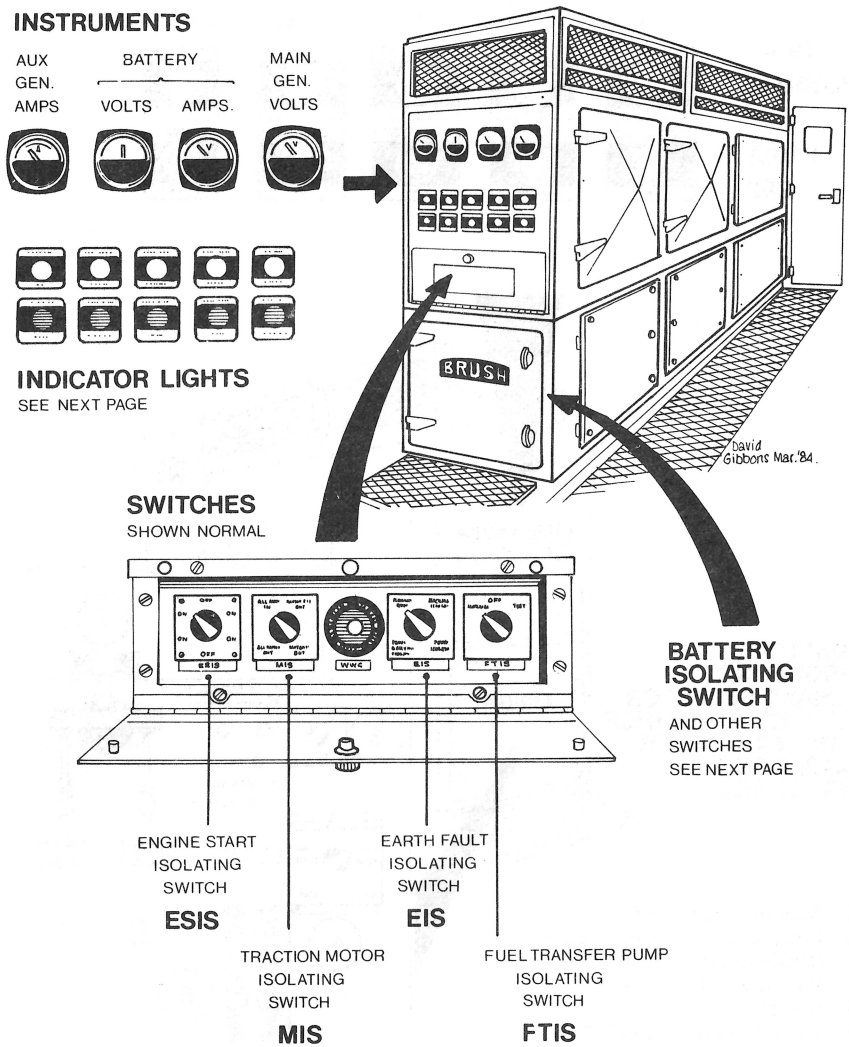
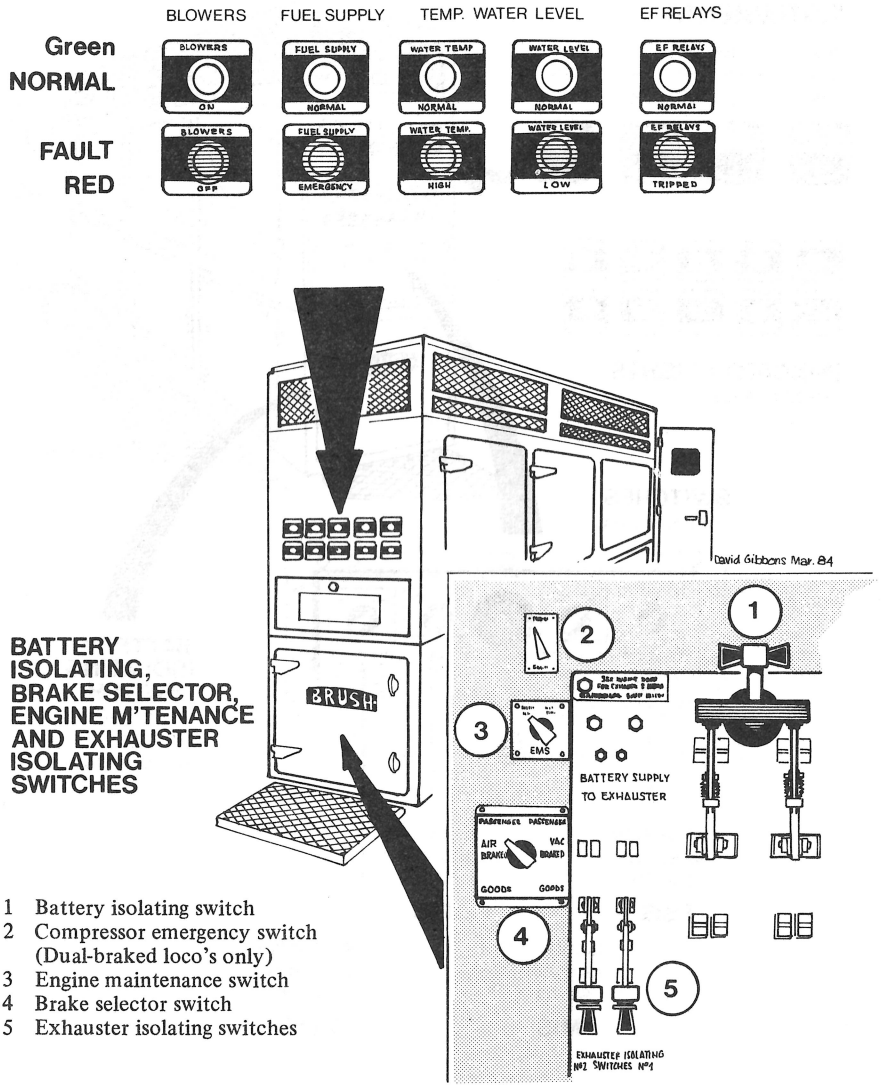
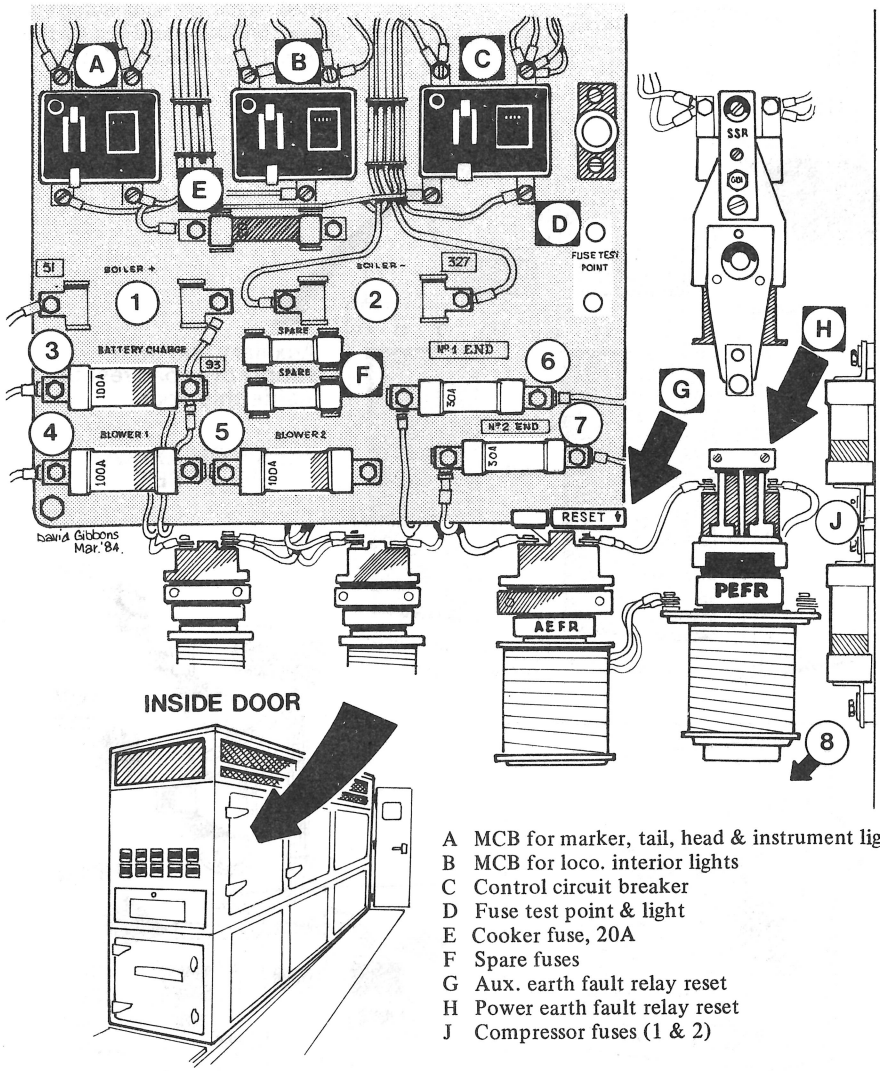


Fig.14 Control Cubicle 2



1 Battery isolating switch
2 Compressor emergency switch (Dual-braked loco's only)
3 Engine maintenance switch
4 Brake selector switch
5 Exhauster isolating switches

Fig.15 Control Cubicle 3
Fuses, relays and mcb's

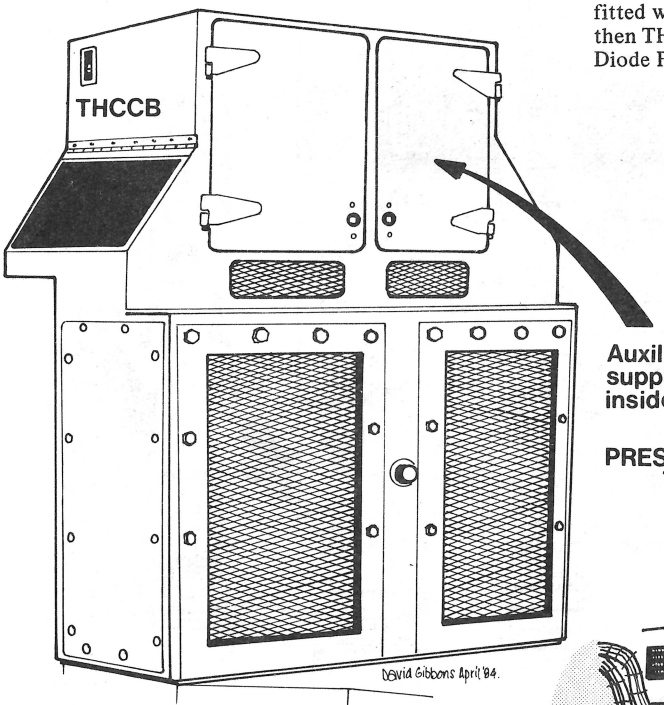


A MCB for marker, tail, head & instrument lights
B MCB for loco. interior lights
C Control circuit breaker
D Fuse test point & light
E Cooker fuse, 20A
F Spare fuses
G Aux. earth fault relay reset
H Power earth fault relay reset
J Compressor fuses (1 & 2)

1&2	Boiler + & –	4&5	T.M. Blower 1 & 2	8	Spare fuses grouped below.
3	Battery charge	6&7	Cab heat 1 & 2		

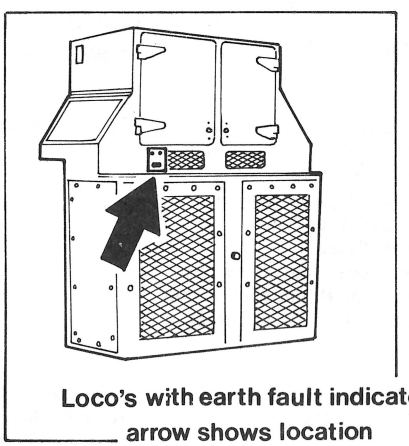
Fig.16 E.T.S. Cubicle
Loco's 31401-424

NOTE: When a particular locomotive is fitted with earth fault indicators then THEFR2 is replaced by the Diode Failure Relay (DFR).

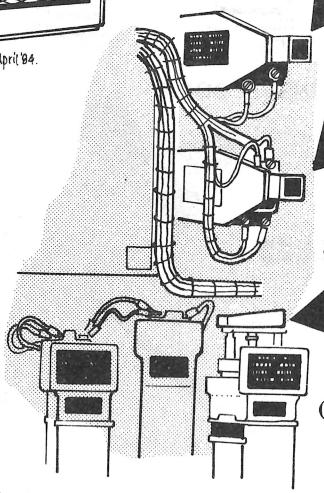


Auxiliary and train supply overload resets inside this door.

PRESS ON ARROW TO RESET



Loco's with earth fault indicators: _____ arrow shows location



OR DFR (See Note above)

PART B – LOCOMOTIVES WHICH HAVE BEEN REFURBISHED.

These may be readily identified by the circuit breakers now located on the end of the control cubicle and by the provision of rotary type switches for the BIS and for exhauster isolation in place of the former knife type switches, the latter taking the place of the earth isolating switch. Note also the transparent lower panels to the control cubicle at No.2 end.

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	9. Partial loss of traction power – Yellow 'wheelslip' indicator light BRIGHT.	51

10. Partial loss of traction power/locomotive does not develop full power – Desk indicator lights normal – all DIM. 52

THE FOLLOWING FAULTS APPLY TO CLASS 31/4 LOCOMOTIVES ONLY – WHEN AN ELECTRIC TRAIN SUPPLY (ETS) IS TO BE PROVIDED.

11. Electric Train Supply (ETS) indicator light does not illuminate when the ON button is pressed. 52

12. Electric Train Supply (ETS) indicator light is extinguished when ON button is released. 53

13. Electric Train Supply (ETS) indicator light is extinguished whilst running. 53

7. Illustrations:

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1. WARNING AND OTHER INDICATIONS

The usual indications are provided:

1.1 In the driving compartments – Three indicator lights on the driving desk which are DIM when normal or BRIGHT (or EXTINGUISHED) when there is a fault condition.

Red BRIGHT	–	diesel engine stopped/running
Yellow BRIGHT	–	wheelslip, or fault developing in a traction motor or its associated circuitry.
Blue BRIGHT	–	general fault indication (refer to subsidiary panel as necessary).

In addition there is a white indicator light on Class 31/4 locomotives which, when illuminated, shows that an Electric Train Supply (ETS) has been established.

1.2 At No.2 end of the locomotive – Five further indicator lights on a subsidiary panel on the front of the main control cubicle. These are in vertical pairs which are illuminated GREEN (top) when the particular condition is normal, or RED (bottom) where there is a fault condition.

Traction motor Blowers	–	RED when a traction motor blower has failed.
Fuel	–	RED when the level in the emergency tank falls to a pre-determined figure i.e. 42 galls sufficient for, say, 30 miles running.
Water Temperature	–	RED when engine coolant temperature has risen to 195°F.
Water Level	–	RED when the level in the coolant header tank falls to a pre-determined point, whereupon the diesel engine will automatically shut down.

NOTE: The water level switch will operate to shut down the diesel engine in all positions of the master switch i.e. FOR, EO, REV and OFF. If the switch has operated whilst the engine has been shut down e.g.

through leakage, then the WATER LEVEL fault indication will be given when the BIS is closed during preparation.

Earth – RED when either a power earth fault or auxiliary earth fault occurs.

In all cases illumination of the RED indicator light on the subsidiary panel will be drawn to the Drivers' attention by the BRIGHTENING of the BLUE 'general fault' indicator light on the driving desk.

1.3 In the driving compartments – Four repeater lights to show the position of the brake selector switch:

vacuum passenger vacuum goods
air passenger air goods

2. FUSES AND THE EFFECT OF THEIR RUPTURING IN SERVICE.

2.1 Boiler (where fitted) 2 x 50 amp – Boiler not operable

2.2 Battery charge 100 amp – Battery charging will cease. If engine is subsequently stopped for any reason it will not then be possible to restart it.

2.3 Compressors 2 x 100 amp – The associated compressor i.e. No.1 or No.2 will stop. If either fuse ruptures the time taken to charge the air system will be excessive and if both rupture air pressure will be lost and a brake application will be initiated when main reservoir pressure falls to 65 psi.

2.4 Blower motors 2 x 80 amp – The associated traction motor blower i.e. No.1 or No.2 will stop.

2.5 Exhausters 2 x 50 amp – The associated exhauster i.e. No.1 or No.2 will stop and difficulty will be experienced in creating vacuum on long trains. If both exhauster fuses rupture then the vacuum brake pipe will be lost.

2.6	Fuel transfer pump 20 amp	– The fuel transfer pump will stop but engine will continue to run, supplied by emergency tank. Low fuel warning will be given when 42 galls remain.
2.7	Lub. oil priming pump 20 amp	– The lub. oil priming pump will not run when the next attempt to start the engine is made i.e. when the master switch is moved to EO.
2.8	Main Generator Field 100 amp	– Traction power will be lost, the 'engine stopped' indicator light and 'general fault' indicator lights both BRIGHT. Engine continues to run.

3. FUSE CHANGING PROCEDURE.

3.1 Stop the diesel engine.

3.2 Open the battery isolating switch.

3.3 Remove the suspected fuse.

3.4 Place suspect fuse on the fuse tester, if it is NOT ruptured the adjacent lamp will illuminate. If the lamp does not illuminate then fuse has ruptured.

3.5 Test a replacement fuse of the correct amperage and position it securely.

NOTE: Where two ratings are listed in Section 2 e.g. 30/32 amp either value may be used as a replacement.

3.6 Close the battery isolating switch.

3.7 Restart the diesel engine and proceed.

NOTE: 1. ONLY ONE SPARE FUSE SHOULD BE USED, IF THIS RUPTURES THE ASSOCIATED CIRCUITRY IS DEFECTIVE AND CANNOT BE USED.

2. ON THESE LOCOMOTIVES THE FUSE TESTER IS ON THE LIGHTING CIRCUIT AND IS THEREFORE AVAILABLE WITH THE BATTERY ISOLATING SWITCH 'OPEN'.

4. MINIATURE CIRCUIT BREAKERS AND THE EFFECT OF THEIR TRIPPING IN SERVICE.

4.1 Control Circuit Breaker – The AWS warning indication will sound

and cannot be reset, brake application will be initiated.

Desk and subsidiary indicator lights extinguished.

4.2	Driving lights MCB	– Marker lights extinguished.
4.3	Maintenance lights MCB	– Driving compartment and engineroom lighting extinguished.
4.4	Cooker/Hotplate	– facility not available.
4.5	Cab heaters No.1 cab and No.2 cab	– facility not available.
4.6	Demister/Footwarmer	– facilities not available.

5. LOCOMOTIVES MODIFIED TO PROVIDE AN ELECTRIC TRAIN SUPPLY (ETS).

Certain locomotives have been so modified, in two batches, and renumbered into the 314XX series i.e. 31401 to 31424 and 31425 to 31468. There are minor differences, so far as the Driver is concerned, and these are dealt with in the fault charts which follow.

5.1 The former auxiliary generator has been replaced by an alternator which has two separate 3-phase output windings, which are rectified to give 2 d.c. outputs, one at 110 volts for the auxiliary machines such as exhausters and compressors and the other at 825 volts for the ETS.

Both the auxiliary and ETS outputs are protected by thermal overload devices which contain an alloy that melts should the current passing through the device become excessive. Once the device has operated to cut off the current then at least 60 seconds must be allowed to elapse to allow the alloy to re-solidify before attempting to reset the overload device by means of the appropriate reset button.

There are two auxiliary overload devices AOL1 and AOL2 – if either operate there will be loss of both traction and ETS supply – see Fault 5c or 6b.

There are also two 'train heat' overload devices THOL1 and THOL2 which, because of manufacturing tolerances, will operate at slightly different excess current values thereby enabling a fault on the train to be detected by THOL1 or THOL2 which immediately opens the train supply contactors to cut off the ETS – see Fault 12b or 13b.

If however the fault is still present i.e. it is within the locomotive circuitry between the ETS output winding and the now-open train supply contactors, then THOL1 and THOL2 will operate to 'trip' the Diode Failure Relay (DFR) which immediately stops the diesel engine – see Fault 2a.

If an auxiliary or ETH rectifier diode fails this will be detected by Rectifier Fault Relays (RFR) which will operate to 'trip' the Diode Failure Relay (DFR) which immediately stops the diesel engine – see Fault 2b.

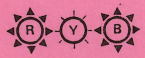
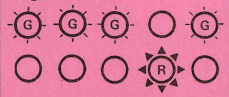
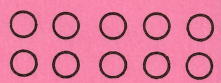
5.2 The train supply control circuits are protected by a Train Heat Circuit Breaker (THCCB). If this trips the ETS will be lost – see Fault 11a.

5.3 The auxiliary supply is protected from a malfunction of the Automatic Voltage Regulator (AVR) by a circuit breaker – see Fault 5b or 6a.

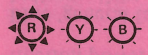
5.4 Located on the ETS cubicle are two lights labelled TRAIN HEAT EARTH FAULT INDICATORS. They are illuminated whenever there is an output from the train heat alternator, whether ETS has been established or not. They are provided to enable maintenance staff to undertake earth tests on the ETS.

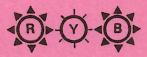
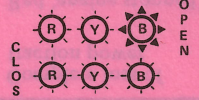
6. FAULT FINDING CHARTS

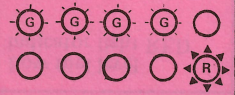
INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
1. Engine STOPS Red 'engine stopped' indicator light BRIGHT 	a. Engine overspeed	–	Check engine overspeed device on free end of diesel engine. If 'tripped' i.e. chrome button **not** protruding then reset. If device trips again immediately on restarting the engine – request assistance. If device trips again when full power is restored reset ONCE MORE and use manual over-ride control handle at drive end of engine to restrict engine r.p.m. If device trips again – request assistance.
	b. Low lub. oil pressure (below 20/22 psi at idling rpm or below 33/36 psi at full rpm)	–	Check red-banded button on diesel engine ('Woodward') governor, if this is protruding then check oil level in sump. If above MAX on dipstick DO NOT ATTEMPT to restart engine (fuel dilution) – request assistance. If between MAX and MIN reset the button on governor and attempt to restart the engine. If oil pressure rises to above 20/22 psi then engine will continue to run when start button is released. If engine does not run and red-banded button again protrudes, or level is below MIN, request assistance.
	c. Fuel starvation (main fuel tank empty)	–	Move Fuel Transfer Pump Isolating Switch to OFF and restart engine. NOTE: automatic changeover to gravity feed was prevented by air pressure on fuel system non return valve.

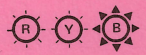
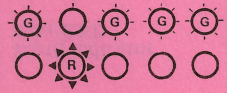
INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
2. Engine STOPS Red 'engine stopped' indicator light BRIGHT Blue 'general fault' indicator light BRIGHT 	a. **CLASS 31/4 ETS LOCOMOTIVES ONLY.** Train Heat Over-load (THOL1 & 2) protective device and Diode Failure Relay (DFR) both tripped	–	Press THOL reset button on r.h.s. of ETS cubicle. **NOTE:** At least 60 seconds must have elapsed from engine shutting down until reset button is pressed. Reset DFR adjacent to THOL reset button and attempt to restart engine. IF DFR trips again request assistance. DRIVERS MAY ATTEMPT TO RESET DFR ONCE ONLY. **OPEN B.I.S. BEFORE ENTERING ETS CUBICLE.**
	b. **CLASS 31/4 ETS LOCOMOTIVES ONLY** Diode Failure Relay (DFR) tripped	–	Reset DFR and attempt to restart engine. If DFR trips again request assistance. DRIVERS MAY ATTEMPT TO RESET DFR ONCE ONLY. **OPEN B.I.S. BEFORE ENTERING ETS CUBICLE.**
	c. Low water level	Water level indicator light RED 	Check water level gauge on header tank and check system for leakage. If level is low and arrangements cannot be made to top-up the system then request assistance.
3. AWS warning sounds and will not reset, brake application Desk indicator lights EXTINGUISHED 	a. Control circuit breaker (CCB) tripped	All extinguished 	Check control circuit breaker at control cubicle at No.2 end. Attempt to reset, if CCB trips again request assistance. THERE MUST BE NO MORE THAN THREE ATTEMPTS TO RESET CCB.

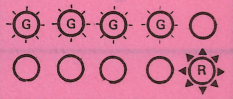
INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
4. Complete loss of traction power Brake application Desk indicator lights normal – all DIM 	Loss of main reservoir pressure (below 65 psi) NOTE: The low main reservoir pressure feature of the brake application unit will vent the air brake pipe	–	Check compressors – if NOT running check compressor governor on l.h.s. of engine room at free end of engine, toggle should be 'up'. If still not running check compressor fuses at control cubicle at No.2 end. **NOTE:** On a dual braked locomotive, running under vacuum conditions, move compressor changeover switch to CHANGEOVER to bring in the other compressor. Change fuse later when convenient. If compressors ARE running check system for leakage – particularly drain cocks, flexible hoses etc. If working two pipe air braked train close cocks between locomotive and train to identify location of loss.
	b. Loss of train pipe vacuum (below 12½ ins.)	–	Check exhausters – if NOT running check that exhauster isolating switch, located adjacent to the fuel transfer pump isolating switch, is at NORMAL. If still not running check exhauster fuses located within control cubicle. If exhausters ARE running check system for leakage, particularly flexible hoses. Part hoses between locomotive and train to identify location e.g. could be passenger communication valve operated.
	c. Loss of air brake pipe pressure (below 42 psi) (Main reservoir pressure adequate – above 95 psi)	–	Check main reservoir pressure is above 95 psi. Isolate AWS and DSD equipment in turn (DSD isolating cock in No.1 nose end) and check if brake pipe pressure is regained after each isolation. If still unable to regain pressure examine flexible hoses and cocks. Close cocks between locomotive and air braked train to identify location of loss e.g. could be passenger communication valve operated.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
5. Complete loss of traction power Red 'engine stopped' light BRIGHT **Engines continues running** 	a. Main generator field fuse (GXF) ruptured		Check fuse and replace if ruptured. If fuse ruptures again request assistance.
	b. **CLASS 31/4 ETS LOCOMOTIVES 31401 to 31424 ONLY** Auxiliary supply protection circuit operated		Check Automatic Voltage Regulator (AVR) on bodyside at No.2 end near vacuum exhausters. AVR will be fitted with either (a) a circuit breaker which will be 'down' if tripped. Attempt to reset to regain traction power, or (b) an AVR TRIPPED warning light – if illuminated press the AVR reset button to attempt to regain traction power. **NOTE:** ONLY THREE ATTEMPTS TO REGAIN TRACTION AUXILIARY POWER ARE PERMITTED. If auxiliary power cannot be restored request assistance.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
6. Complete loss of traction power Red 'engine stopped' light BRIGHT **Engine continues running** Blue 'general fault' indicator light BRIGHT  	a. **CLASS 31/4 ETS LOCOMOTIVES 31425 TO 31468 ONLY** Auxiliary supply protection circuit operated	Overvoltage indicator on ETS cubicle illuminated	Press OVERVOLTAGE RESET button on r.h.s. of ETS cubicle. **NOTE:** Only three attempts to restore auxiliary supply are permitted. If auxiliary supply cannot be restored request assistance.
	b. **CLASS 31/4 ETS LOCOMOTIVES** Auxiliary Overload (AOL1 or AOL2) protection device operated		Press AOL reset button on ETS cubicle. **NOTE:** At least 60 seconds must have elapsed from loss of traction (and ETS) power until reset button is pressed. If traction power cannot be regained i.e. AOL will not reset then request assistance.
7. Complete loss of traction power Blue 'general fault' indicator light BRIGHT when power controller is open, DIM when closed.  	a. Loss of control air pressure (below 49 psi) or Control Circuit Governor (CCG) defective	–	Check control air pressure gauge on bulkhead at No.2 end, normally reads approx. 70 psi. Check that control air isolating cocks near the exhausters at No.2 end are fully open and that the control reservoir drain cock, behind buffer beam at No.2 end, is fully closed. Check CCG (by radiator arch on non-ETS locos, on No.2 end bulkhead on ETS locos), toggle should be 'up'.
	b. **IN VACUUM CONDITIONS** Vacuum Control Governor (VCG) defective (possibly after a brake application)	–	Check VCG on bulkhead at No.2 end, toggle should be 'down'. **NOTE:** VCG should close as vacuum brake pipe rises to 15 ins.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
7. Complete loss of traction power etc. (Continued)	c. Brake Pipe Governor (BPG) defective (possibly after a brake application)	–	Check BPG in No.2 nose end, toggle should be 'up'. **NOTE:** BPG should close as air brake pipe rises to 62 psi.
	d. Load regulator has not run back to MINIMUM position. (possibly after a stop or period of coasting)	–	Check load regulator, if not at MINIMUM i.e. left hand end of its travel then STOP THE ENGINE and open the B.I.S. Using the small handle at the end of the regulator turn it back to MINIMUM, making sure that the contact clips home. Close the B.I.S. restart the engine and proceed.
	e. Traction motor overload Power Earth Fault Relay (PEFR) tripped	– Earth indicator light RED 	Close power controller. Wait 15 seconds to ensure that load regulator runs back to MINIMUM and then reopen controller. If the power is regained then proceed but report the operation of traction motor overloads or tripping of PEFR as necessary. If, when power is regained, the YELLOW wheelslip light is BRIGHT then suspect a defective traction motor. Examine traction motors for signs of overheating and, if evident, isolate the appropriate pair by the switch at the control cubicle. If there is no evidence find the defective pair by trial and error. **NOTES:** 1. If isolation of traction motors has been necessary then arrange for check of axle rotation before continuing. 2. Field diversion will be suspended when traction motors are isolated. 3. With traction motors isolated max. amps not to exceed: 1000 for brief periods (not exceeding one minute) when starting away. 850 during acceleration. 600 continuous whilst running.

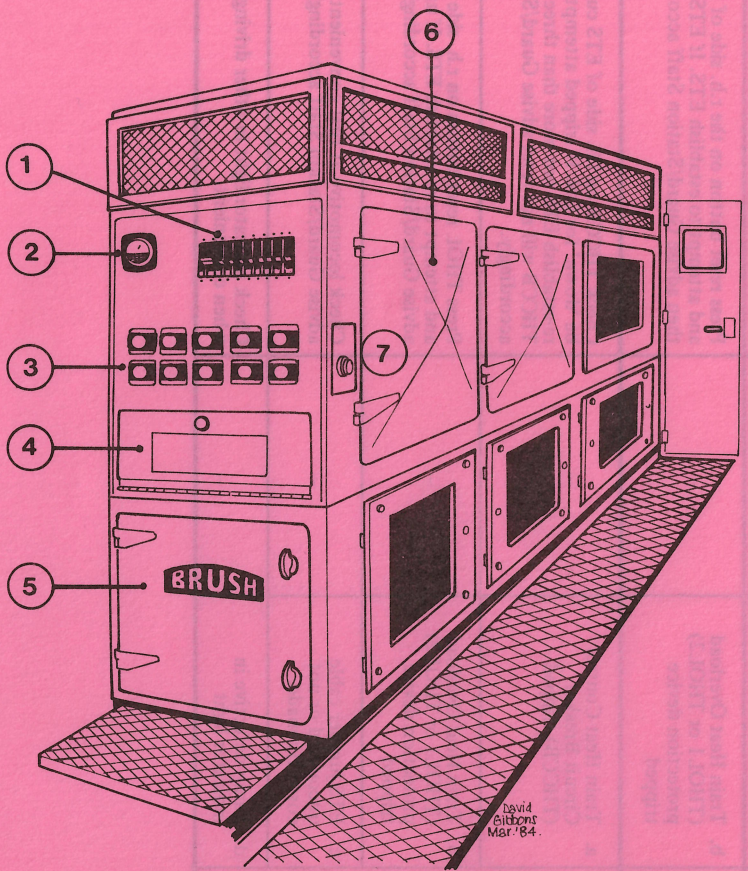
INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
8. Blue 'general fault' indicator light BRIGHT when power controller is open, remains BRIGHT when controller is closed. No loss of traction power. 	a. High water temperature (above 195°F)	High Water temperature indicator light RED 	Reduce power to notch 2 when possible and, if blue 'general fault' indicator light then dims, proceed. When convenient check that radiator shutters are fully open (levers are situated on either side at free end of engine) and water level gauge on header tank. If level is getting low and arrangements cannot be made to top-up the system, or there is evidence of leakage, then clear running lines and request assistance as necessary.
	b. Low fuel level (possibly only some 42 galls remaining)	Low fuel level indicator light RED 	At first convenient point check main and emergency tank gauges, if main tank shows EMPTY and emergency tank shows approx. 42 galls with fuel transfer pump still running, then 'low fuel' indication is correct. There is sufficient fuel for approx. 30 miles running-move Fuel Transfer Pump Isolating Switch (F.T.I.S.) to OFF and arrange to clear running lines/ obtain fuel/ request assistance as necessary. If main tank shows adequate contents check if fuel transfer pump is running. If not running check fuel transfer pump fuse. If pump still does not run turn F.T.I.S. to TEST' If pump still does not run then move F.T.I.S. to OFF – fuel transfer pump has failed, leaving sufficient fuel for approx. 30 miles running. Arrange to clear running lines/request assistance as necessary.
	c. Traction motor blower stopped	Traction motor blower indicator light RED 	Reduce power to notch 2 when possible and, at first convenient point, check which blower has stopped and if either fuse is ruptured then change. If replacement fuse also ruptures, or fuses are sound and blower still does not run, then proceed keeping power as low as possible and request assistance as necessary.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
8. Blue 'general fault' indicator light etc. (Continued)	d. Auxiliary earth fault	Earth indicator light RED 	Complete journey – enter defect in repair book.
9. Partial loss of traction power Yellow 'wheelslip' indicator light BRIGHT	a. Wheelslip	–	Ease power controller to a position at which the wheelslip light remains DIM. If rail conditions are very poor then close controller, apply sand and reopen controller slowly.
	b. Traction motor fault developing	–	If wheelslip light is BRIGHT and it is evident that there is no wheelslip, then stop at first convenient point and examine traction motors for signs of overheating etc. If evident isolate the appropriate pair by the switch at the control cubicle. If there is no evidence find defective pair by trial and error i.e. yellow wheelslip light remains DIM when controller is opened. **NOTES** 1. Arrange for check of axle rotation before continuing. 2. Field diversion will be suspended when traction motors are isolated. 3. With traction motors isolated max. amps NOT to exceed: 1000 for brief periods (not exceeding one minute) when starting away. 850 during acceleration 600 continuous whilst running.

INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
10. Partial loss of traction power/locomotive does not develop full power Desk indicator lights normal – all DIM 	a. Fuel racks not fully open	–	When convenient check that manual over-ride control handle at drive end of engine is fully at the TOP of the quadrant.
	b. Loss of regulating air pressure	–	When convenient check system e.g. flexible hoses, cocks, connections to governor, master switch away from OFF in unoccupied driving compartment (with or without a master key in position) etc. etc.
	c. Traction motors isolated (by a previous person)	–	Check isolating switch on end of control cubicle when convenient. If no appropriate entry in the repair book de-isolate. Report facts in repair book as appropriate.
	d. Charging air pressure low	–	When practicable check charging air pressure gauges which should indicate 5 psi when power controller is fully open.
11. **CLASS 31/4 LOCOMOTIVES ONLY** Electric Train Supply (ETS) indicator light does not illuminate when the ON button is pressed.	a. Lamp defective in indicator light	–	Check indicator light in the other driving compartment.
	b. Train Heat Control Circuit Breaker (THCCB) tripped	–	Check THCCB on l.h. side of E.T.S. cubicle, should be 'down' for ON. If tripped attempt to reset and establish ETS not more than three times. If THCCB will not reset then locomotive is unable to provide ETS, advise Guard/Station Staff accordingly.
12. **CLASS 31/4 LOCOMOTIVES ONLY** Electric Train Supply (ETS) indicator light is extinguished when ON button is released	a. ETS jumper cables not correctly coupled or not correctly stored in in dummy sockets.	–	Check locomotive and advise Guard/Station Staff accordingly. Arrange for ETS jumper cables to be uncoupled between locomotive and train as necessary to establish where fault lies.

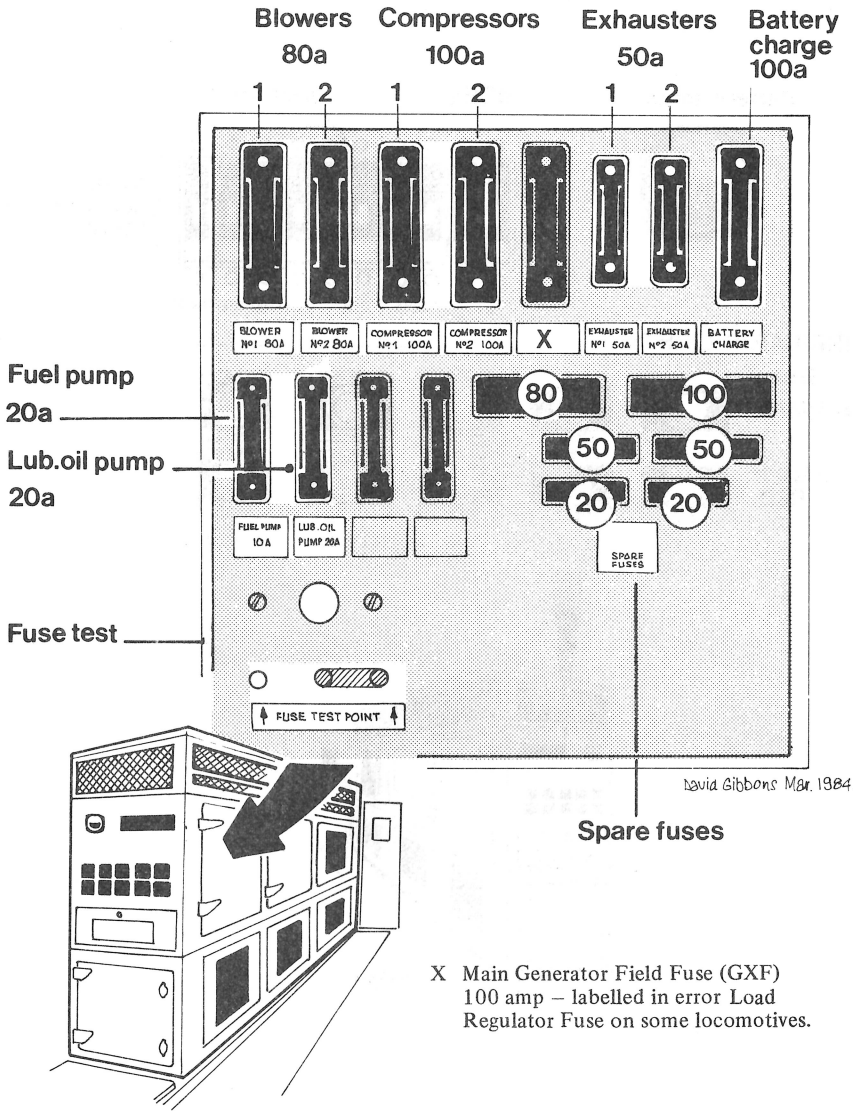
INDICATIONS IN DRIVING COMPARTMENT	POSSIBLE CAUSE	SUBSIDIARY INDICATIONS AT CONTROL CUBICLE	RECOMMENDED ACTION
12. **CLASS 31/4 LOCOMOTIVES ONLY** Electric Train Supply etc. (Continued)	b. Train Heat Overload (THOL1 or THOL2) protection device tripped	–	Press reset button on the r.h. side of ETS cubicle and attempt to establish ETS. If ETS not available then advise Guard/Station Staff accordingly.
13. **CLASS 31/4 LOCOMOTIVES ONLY** Electric Train Supply (ETS) indicator light is extinguished whilst running	a. Train Heat Control Circuit Breaker (THCCB) tripped	–	Check THCCB on l.h. side of ETS cubicle, should be 'down' for ON. If tripped attempt to reset and re-establish ETS not more than three times. If THCCB will not reset advise Guard/Station Staff accordingly.
	b. Train Heat Overload (THOL1 or THOL2) protection device tripped	–	Press THOL reset button on r.h. side of ETS cubicle and attempt to re-establish ETS. If unable to do so advise Guard/Station Staff accordingly.
	c. ETS jumper cable uncoupled or not correctly made.	–	Check locomotive at first convenient point and advise Guard/Station Staff accordingly.
	d. Lamp defective in indicator light	–	Check indicator light in other driving compartment when convenient.

Fig.17 Control Cubicle
Refurbished Loco's



1 Miniature circuit breaker (mcb's) for control, cab lights & heating
2 Battery ammeter (other instruments removed)
3 Control cubicle indicator lights (unchanged)
4 Switches for Engine start isolating, Motor isolating, Fuel transfer isolating. New 'Exhauster isolating switch' replaced Earth isolating switch.
5 Battery isolating switch modified. Exhauster isolating switch replaced (see 4).
6 Fuses, relays and mcb's inside. Fuses modified.
7 Lighting delay switch

Fig.18 Control Cubicle Fuses
Refurbished loco's



X Main Generator Field Fuse (GXF) 100 amp – labelled in error Load Regulator Fuse on some locomotives.

Fig.19 Control Cubicle Lights
Refurbished loco's

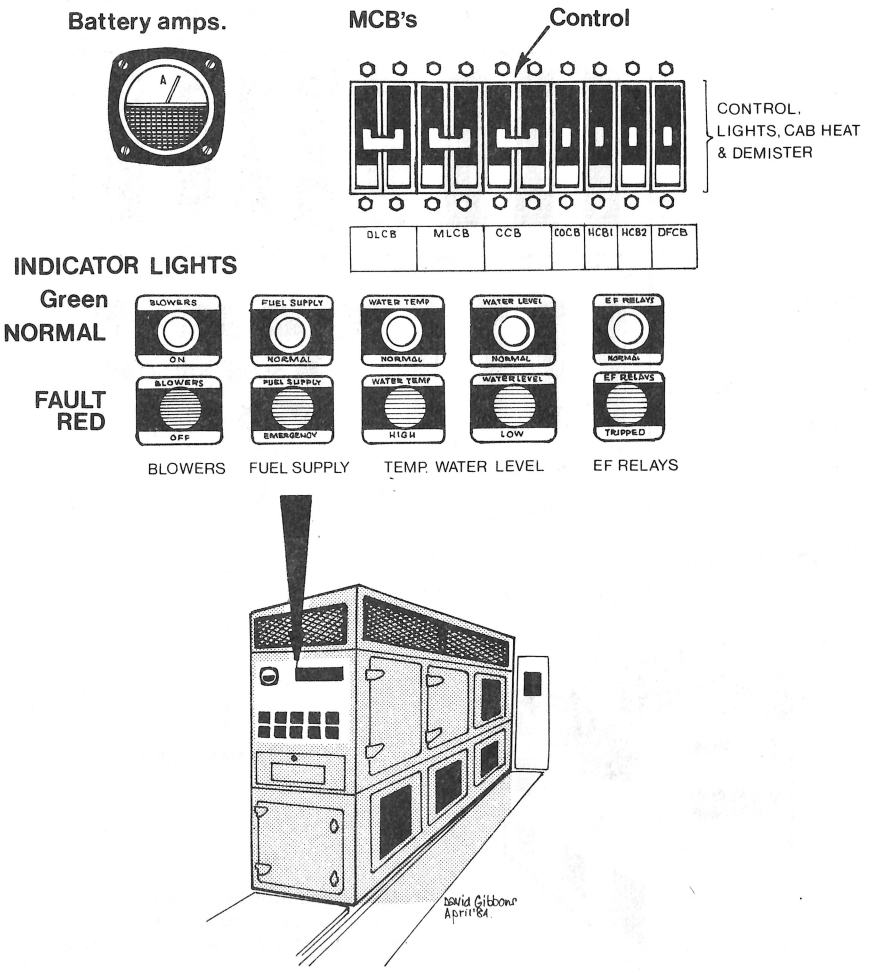
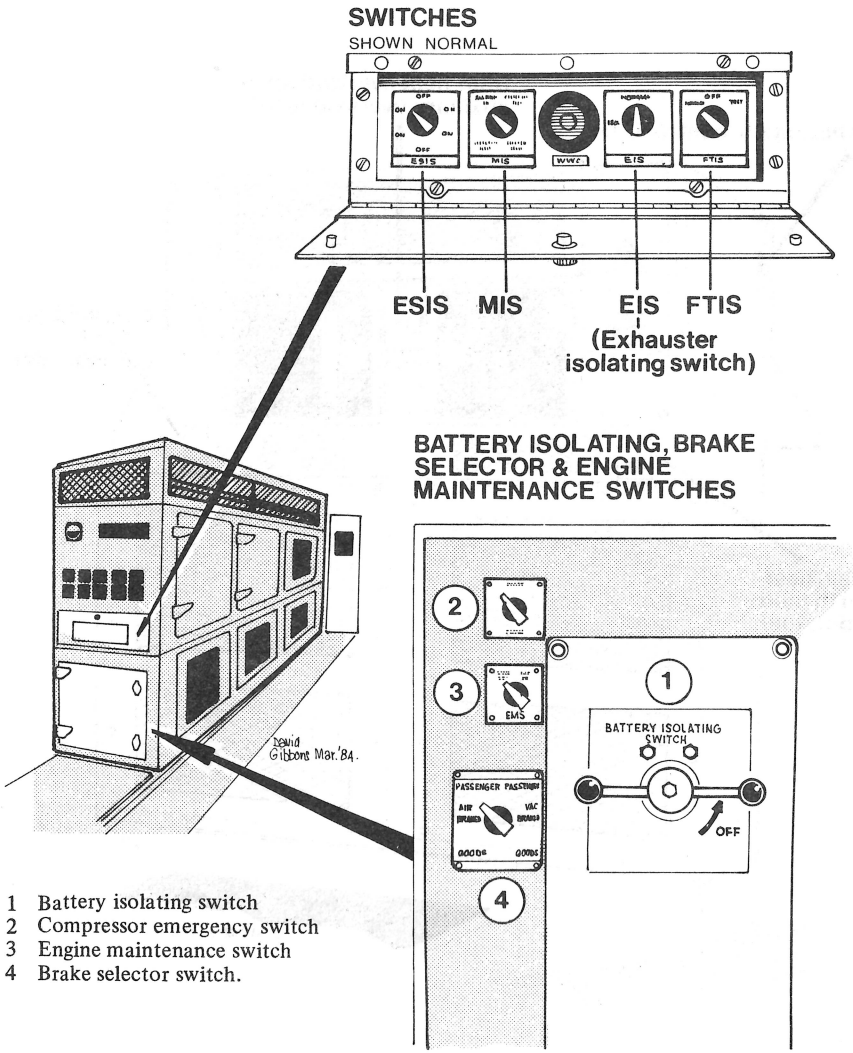


Fig.20 Control Cubicle Switches
Refurbished loco's



1 Battery isolating switch
2 Compressor emergency switch
3 Engine maintenance switch
4 Brake selector switch.

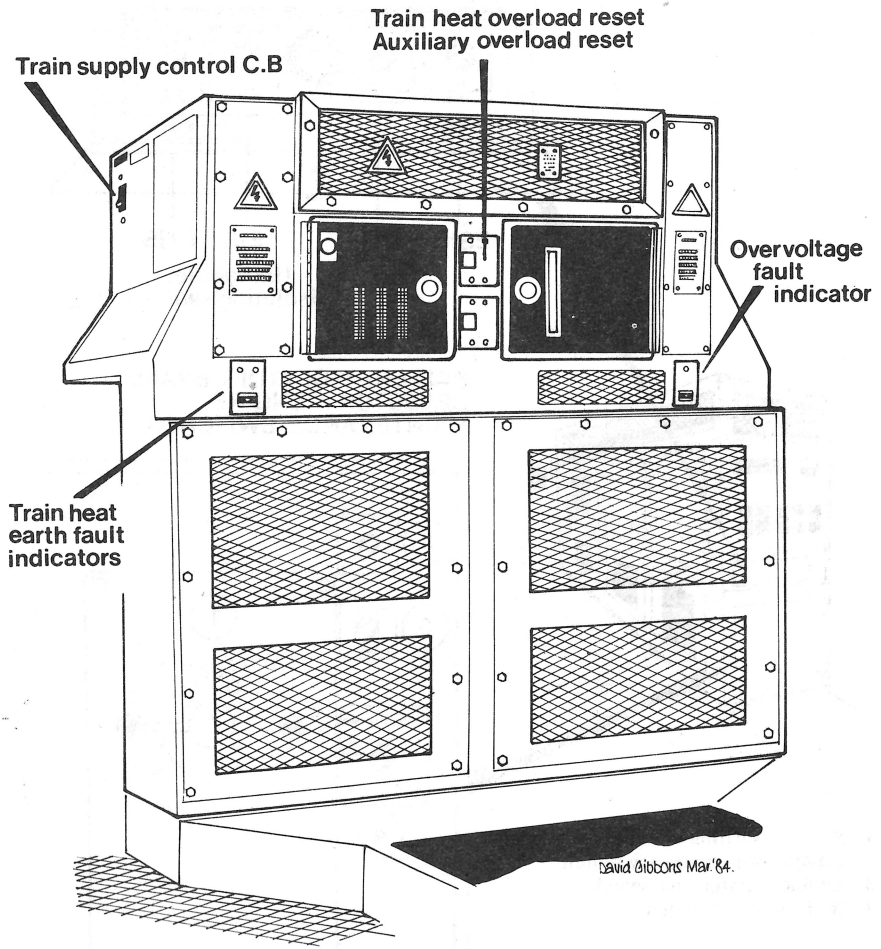



Fig.21 E.T.S. Cubicle
Refurbished loco's